EXPERIMENTAL TELEVISION CENTER STUDIO DOCUMENTATION (2005)

Section 1: General ETC Studio Notes (Hank Rudolph)

Section 2: + / -5V System Manual : Yellow Boxes (Richard Brewster) 1978 & 1984.

Section 3: Raster Manipulation Unit (Sherry Miller Hocking w/ Richard Brewster and Walter Wright) 1978-80

TYPES OF SIGNALS IN THE SYSTEM	METHODS OF ROUTING SIGNALS
1. Composite Video	Matrix Switcher and Video Patch Bay
2. Y/C Video	Black Svideo switch boxes / prepatched
3. Audio	Audio Patch Bay
4. + / - 5 Volt	Mono mini cables directly to and from devices
5. MIDI (Musical Instrument Digital Interface)	MIDI Patch Bay
6. Sync	Pre-patched
7. DV	Firewire cables directly to and from devices
8. +/ - 1/2 Volt (Sandin-Sippel Image Processor)	BNC cables directly to and from devices.

TYPES OF AUDIO SOURCES

1. Microphones
2. Audiotape
3. Audio tracks of video media
4. CD Player
5. Electronically Generated
   Analog : Oscillators, Random Signal Generators
   Sampled Sounds & Audio Software

METHODS OF AUDIO PROCESSING:

REAL TIME PROCESSING:
CHANGING PARAMETERS OF A SOUND

1. Changing Waveshape
2. Changing Amplitude
3. Digital Processing:
   Harmonizer, Delay, Reverb, Ring Modulation, Flanging,, Chorusing, Pitch Shifting and Detuning.
4. Switching & Mixing

SAMPLING, LOOPING & EDITING SOUND

ETC STUDIO

- Cardioid (2)
- Audio cassette deck (1)
- SVHS , DV, DVD
- G4, CD/ DVD Player

- + / - 5 V System and Korg MS-20 Synthesizer
- Mirage Keyboard Sampler, Amiga 2000: Audio-master, Harmonizer, M
  G4: Max/MSP, Logic Express, FCP

- Alesis Quadraverb 2 (Q 2), +/- 5V: VC Filter, Waveshaper, Comparators / Doepfer: Vocoder, Frequency Shifter / Korg MS20 Filters,
- +/- 5V: Dual VC Amplifier / Korg MS20 VCA / Doepfer: VC Mixer & Ring Modulator
- Amiga: Harmonizer / Alesis Quadraverb 2 (Q2)
  G4: Max/MSP, Pluggo

- 8 Channel Sequencer (w/ VC inputs and + / - 5 V output)
- Behringer 16-Channel Mixer/ Doepfer VC Mixer/
- +/- 5V: Dual VCA, Mixers

- Amiga: Audiomaster , Mirage Keyboard Sampler,
- G4 : Max/MSP, Logic Express, FCP

TYPES OF CONNECTORS USED IN THE SYSTEM

Connector	Signals	Interface in the ETC System
BNC	Composite Video	Sandin-Sippel Image Processing System (SSIP) inputs and outputs of external video devices
Trompeter	Composite Video	Video Patch Bays
RCA	Composite Video/ Audio	External audio/video devices (CD players, VHS decks)
S-Video	Y/C Video	Switch Boxes to TBC's A, C and D, from camcorders, SVHS & DV decks, G4 analog output, external devices
1/4" Mono	Audio	Audio Patch Bays, Behringer Mixer ,Korg MS20 Synthesizer and external audio devices (keyboards, guitars, effects processors).
Mini (mono)	Control Voltages	+/ - 5 Volt System, Doepfer analog modules
Mini (stereo)	Audio	Headphone jacks, line outputs of portable audio devices (minidisc recorders, portable CD) audio to and from G4
XLR	Audio	Microphones to Behringer Mixer mic inputs
Firewire	DV	G4, DV decks & camcorders, DVD Recorder. Canopus ADVC-100

TYPES OF VIDEO IMAGE SOURCES	ETC STUDIO
1. Studio Cameras 2. Videotape 3. Electronically Generated Computer Generated Analog Generated Waveform Color	• Black and White (2) , Color (4) • VHS , DV, 3/4" with Time Base Correctors • Amiga 2000: Dpaint IV, Brilliance • G4 : Flash MX, After Effects , Text (FCP) • +/-5 Volt Analog System: Oscillators, Random Signal Generators • Jones Colorizer, Sandin-Sippel Image Processor
METHODS OF VIDEO IMAGE PROCESSING:	
REAL TIME PROCESSING: CHANGING PARAMETERS OF A SINGLE IMAGE 1. Changing the gain and pedestal , chroma level, and phase 2. Changing polarity (image negative) 3. Removing chrominance (monochromatic) 4. Resizing , cropping and/ or repositioning image 5. Real time digitization; changing image resolution 6. Strobing 7. Inverting image horizontally and vertically 8. Raster Deflection 9. Adding chrominance (colorization) 10. Manipulation of grey levels COMBINING IMAGES	• Time Base Correctors (TBC), Output Amp, Individual Channels of Keyers, Colorizer, and Sequencer • Colorizer, Microtime DVE, Sandin-Sippel Image Processor (SSIP): Adder/Multiplier, Fairlight CVI • Color Kills, TBC's • DVE, Fairlight • A-Live 2000, Designlab Frame Buffer (FB-1), DVE, Fairlight • DVE, TBC A & C, FB-1, Fairlight • DVE, Paik-Abe Raster Device (aka Wobulator), Fairlight • Wobulator • Jones Colorizer, FB-1, SSIP, Fairlight • SSIP: Amplitude Classifier, Differentiator, Function Generator
1. Switching 2. Mixing • Additive • Non-Additive (Layered) 3. Luminance Keying 4. Wipes 5. Digital image collage STORING AND LOOPING IMAGES	• Crosspoint Latch Switcher Jones 8 Channel Sequencer • CL Switcher, SSIP: Adder/Multiplier and 36-Channel Mixer, Fairlight • Jones Colorizer • Jones Keyers 1 & 2, Individual Channels of Jones Colorizer, FB-1, SSIP: Adder/Multiple , Fairlight • CL Switcher, Jones Keyers and Sequencer with +/- 5 V signals, Fairlight • FB-1, Fairlight
1. Freezing a single frame or field 2. Capturing, playing back and looping frame sequences 3. Changing speed or direction of frame sequences	• TBC's, DVE, FB-1, Fairlight • G4 with Final Cut Pro (FCP), FB-1, Live 2000 • G4 w/ FCP, FB-1, VHS # 3

ETC VIDEO SIGNAL FLOW OVERVIEW

Video Patch Bays | **Matrix Video Switcher** | **Video Patch Bays**

Source VTR's
(SVHS, DV,
3/4")
DVD Players
Camcorders
Canopus DV-Analog
External Video

Preview
Monitors

Distribution
Amps

TBC's

Studio
Cameras

Electronically
Generated

Main Video Processors

Jones Luminance Keyers
Jones Colorizer/ Mixer
Jones 8-Ch Sequencer
Crosspoint Latch Switcher
Designlab Frame Buffer
Sandin-Sippel IP
Fairlight CVI
Sony Chroma Keyer

Output
Amplifier

Distribution Amps
Record VTR's
(SVHS, DV)
DVD Recorder
Program Monitors
Waveform Monitor
Vectorscope
Cross-Pulse Mon.

Spare
Outputs

Monitors
Video Projector
Canopus Analog-DV
External Video

AUDIO SIGNAL FLOW OVERVIEW

Audio Patch Bays

Sources

Microphones
VTR's
CD/ DVD Players
Audiocassette
Mirage Keyboard
Korg MS20 Synthesizer
G4 (analog out andCanopus)
Electronically Generated
External Audio

Audio Processors

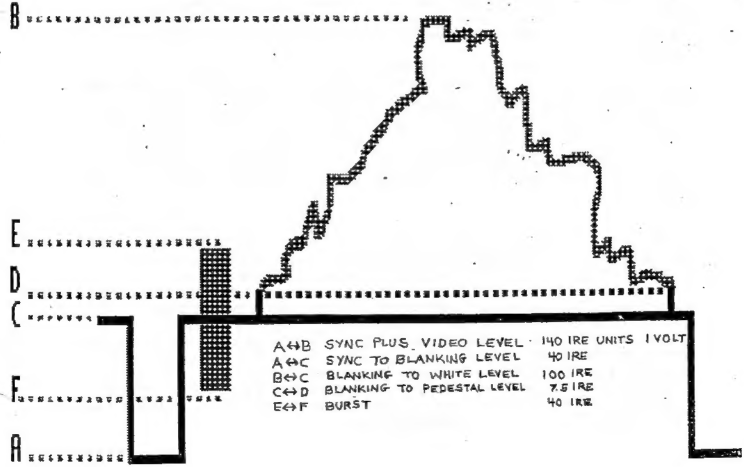
16 Channel Mixer
Quadraverb 2
Amiga 2000 (Harmonizer)
Doepfer Vocoder
Doepfer Frequency Shifter
Doepfer Ring Modulator
G4 with MSP
Mirage Sampler
Voltage Controlled Filters,
Amplifiers and Mixers

Record VTR's
(SVHS, DV)
G4 (CD-R's)
Amplifier & Speakers
Audiocassette
External Audio

PARAMETERS OF THE VIDEO SIGNAL

- **LUMINANCE**
  - **GAIN** *AKA* **CONTRAST, VIDEO LEVEL**
  - **PEDESTAL** *AKA* **BRIGHTNESS, SET-UP, BLACK LEVEL**
- **CHROMINANCE**
  - **CHROMA PHASE** *AKA* **HUE**
  - **CHROMA LEVEL** *AKA* **SATURATION**

MACHINES THAT MONITOR THEM	**WAVEFORM MONITOR**	**VECTORSCOPE**
MACHINES THAT CHANGE THEM	**PROCESSING AMPLIFIERS, TIME BASE CORRECTORS, OUTPUT AMP, INDIVIDUAL CHANNELS OF JONES KEYERS 1 & 2, JONES COLORIZER/MIXER, AND JONES 8- CH SEQUENCER**	**PROCESSING AMPLIFIERS, TIME BASE CORRECTORS, OUTPUT AMP (PHASE ONLY)**



Time Base Correctors:

Time Base Correctors, or TBC's are necessary for having sync information from an external video signal be compatable with the rest of the ETC system.

Examples of external video signals include those coming from prerecorded tapes, a camcorder being used as a live camera in the studio, a digital video mixer (such as those from Videonics and Panasonic) that are not otherwise externally syncable, and the Canopus ADVC-100 for converting a firewire signal from the Macintosh G4 to analog video . For any of these to be used as a source to the ETC system, they each have to pass through an individual TBC.

There are 5 TBC's in the system:

TBC A is a DPS Personal TBC III, a card inside the Amiga 4000 computer. It has both an svideo (Y/C) and composite video input. The composite video input is on the patch bay. The svideo input can be selected by the black switch box near the Amiga with a cable for external sources such as your camcorder.To switch between composite and s-video , you need to select the input in the TBC III software on the Amiga. The software also provides processing amplifier (or proc amp) controls for the TBC. The parameters are labeled "black" (pedestal), "video" (gain) , hue (chroma phase) and "chroma" (saturation) and are slider bar controls. There are also controls for freeze-field, freeze-frame and strobe. These are selected by a 3 position button on the menu. The "Take" button, when selected, will acttivate one of the three choices. There is a slider bar for controlling the strobe rate. The "Mono" button will make the image black and white.

TBC B is a For-A. It has a composite input only.The proc amp controls are a set of four switches and knobs on the front panel. For each parameter, when the switch is down , the knob is inactive and the signal output is at unity. When the switch is up, adjustments can be made with the knob. The parameters are labelled " video " (gain), "chroma level" (saturation), "chroma phase", and "set-up" (pedestal). There are two red pushbuttons for freeze-field and freeze-frame. The "monochromatic" switch will make the video signal black and white.

TBC C is a DPS Personal TBC IV, a card inside the Amiga 2000, and has both svideo and composite video inputs. It has an svideo switch box near the computer. The software controls are similiar to TBC A. If you're using Jitter, TBC C is used as an output.

TBC D is also a DPS Personal TBC IV, card inside the Amiga 2000, and has both svideo and composite video inputs. The TBC IV menu controls both TBC's C and D. Select "TBC 1" to control C, and "TBC 2" to control D. Each TBC has seperate proc amp adjustments. as well as controls for strobe, freeze frame, monochrome, and svideo/ composite video selection. To choose an input type, select "PREFS", then select "svideo" or "composite"

TBC E is a For-A and has a composite video input only .Its controls are identical to those of TBC B.

For all of the TBC's, the composite inputs are selected on the video patch bays.
The TBC's have individual outputs on the video patch bay for sending the signal to preview monitors. They also have three outputs each on the matrix switcher.

Every time a color signal is split on the matrix a certain amount of saturation is lost. If you are sending a TBC to more than one device in the sytem, use its multiple outputs on the matrix when available. For example, if you are sending TBC A to the Sequencer, the Crosspoint Latch Switcher and Jones Keyer 1 simultaneously, send matrix output H to the Sequencer, I to the switcher, and J to the keyer. There are also individual chroma level controls on four of the tbc's to boost or lower the saturation of that signal.

Although the overall hue of the final signal is determined by the Output Amp's chroma phase control, the relative hues of each tape source can be controlled to some extent by the chroma phase controls on the individual tbc's.

	A B+W CAMERA	B B+W CAMERA	C COLOR CAMERA	D COLOR CAMERA	E COLOR CAMERA	F COLOR CAMERA	H,I+J TBC A	K,L+M TBC B	N AMIGA 2000	O,P,Q+R TBC C	S,T+U TBC D	W+X TBC E	Y ±5V To VIDEO 1	Z ±5V To VIDEO 2	AA Amiga 4000	BB Sandin-Sippel	CC Sandin-Sippel	DD Sandin-Sippel	EE Chroma Keyer	FF Color Kill #1	GG Color Kill # 2	HH Fairlight A	II Fairlight B	JJ & KK CL Switcher	LL & MM DVE Pgm	NN DVE Key Out	OO Sequencer	PP Jones Keyer 1	QQ Jones Keyer 2	RR Jones Colorizer	SS FB-1 B&W	TT FB-1 Color	UU fr. Patch Bay	VV fr. Patch Bay
Jones Output Amp 58																																		
Color Kill #2 57																																		
Color Kill #1 56																																		
Frame Buffer Clip 55																																		
Frame Buffer Video 54																																		
Jones Keyer 2 C 53																																		
Jones Keyer 2 B 52																																		
Jones Keyer 2 A 51																																		
Jones Keyer 1 C 50																																		
Jones Keyer 1 B 49																																		
Jones Keyer 1 A 48																																		
Sequencer Ch 7 47																																		
Sequencer Ch 6 46																																		
Sequencer Ch 5 45																																		
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Microtime DVE 32																																		
CL Switcher Key 2 31																																		
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CL Switcher Ch 8 29																																		
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Spare to Patch Bay 20																																		
Spare to Patch Bay 19																																		
Amiga 2000 Genlock 18																																		
Amiga 2000 A-Live 17																																		
16																																		
15																																		
Sony ChromaKey B 14																																		
Sony ChromaKey A 13																																		
FairlightB Stencil 12																																		
Fairlight B Video 2 11																																		
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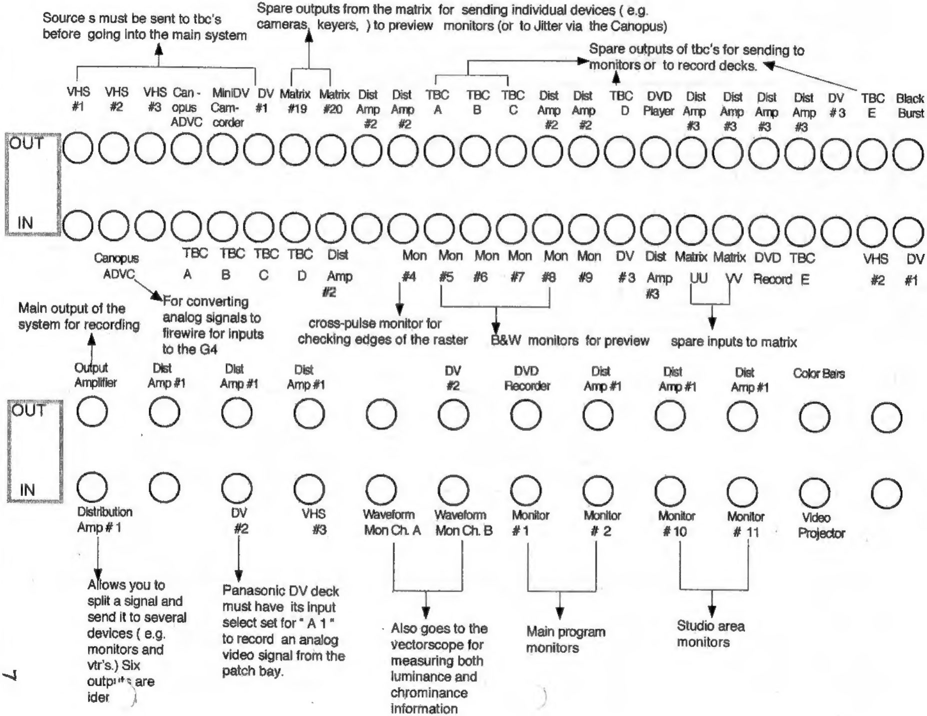
Experimental TV Center Video Routing System: the Matrix Switcher.

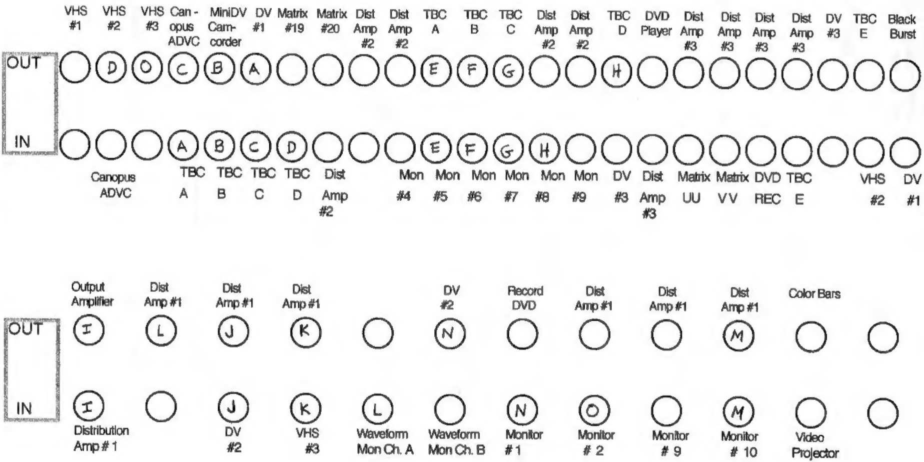
Most of the video processing tools in the system are connected through the matrix switcher. Instead of using patch cables, as with the patch bays, connections are made between device inputs and outputs by setting the sliders at certain x,y coordinates.. Some of the image sources (e.g. studio cameras) are connected directly to the matrix. Others , such as vtr's, are connected to TBC's at the patch bay, which in turn, are connected to the matrix. For almost every processing device that has an input , or destination point labelled at the top of the matrix, there is a corresponding output labelled along the side. The final destination point is always the Jones Output Amp (O.A.). Whatever device is in the matrix's rightmost column goes to the O.A. and back to the video patch bay for recording and monitoring..

Experimental TV Center Video Patch Bays

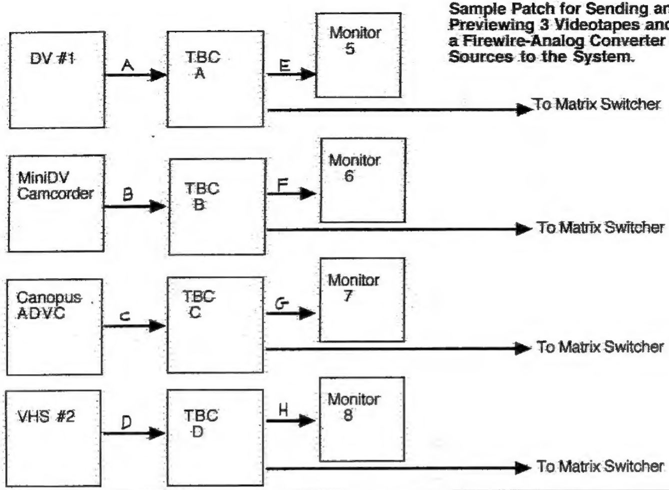


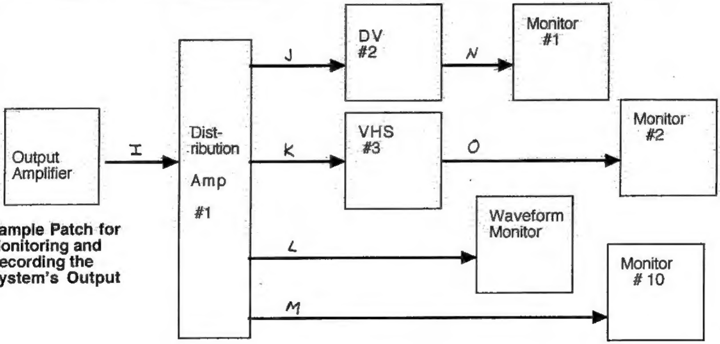
Experimental TV Center Video Patch Bays

SAMPLE VIDEO PATCH



Sample Patch for Sending and Previewing 3 Videotapes and a Firewire-Analog Converter as Sources to the System.





Sample Patch for Monitoring and Recording the System's Output

Experimental Television Center Au[illegible] Patch Bays 5-07-05

Audio Patch Bay 1

	OUT	IN
1	DV #1 L	
2	DV #1 R	
3	DV #3 L	Mac G4-A L
4	DV #3 R	Mac G4-A R
5	Mac G4-A Analog L	
6	Mac G4-A Analog R	
7	VHS # 1 L	Canopus ADVC-100 L
8	VHS # 1 R	Canopus ADVC-100 R
9	Canopus ADVC-100 L	Audiotape Cassette L
10	Canopus ADVC-100 R	Audiotape Cassette R
11	DVD/CD Player L	Mac G4-B L
12	DVD/CD Player R	Mac G4-B R
13	+/- 5 V to audio lines 1	
14	+/- 5 V to audio lines 2	Sippel Env Fol
15	Mac G4-B Analog L	Fairlight audiotrigger #1
16	Mac G4-B Analog R	Fairlight audiotrigger #2
17	VHS # 2 L	DV # 1 L
18	VHS # 2 R	DV # 1 R
19	Audiotape Cassette L	Frequency Equalizer L
20	Audiotape Cassette R	Frequency Equalizer R
21	VHS # 3 L	DV #3 L
22	VHS # 3 R	DV #3 R
23	Korg MS20	VHS # 3 L
24	Mirage Kbd	VHS # 3 R

Audio Patch Bay 2

	OUT	IN
1	Sends / Aux Outputs (Behringer Mixer) 1	Alesis Quadraverb2 L
2	Sends / Aux Outputs (Behringer Mixer) 2	Alesis Quadraverb2 R
3	Sends / Aux Outputs (Behringer Mixer) 3	Audio to +/-5 V 1
4	Sends / Aux Outputs (Behringer Mixer) 4	Audio to +/-5 V 2
5	Sub-group Outputs (Behringer Mixer) 1	MIRAGE KBD SAMPLER
6	Sub-group Outputs (Behringer Mixer) 2	Korg MS20 ESP
7	Sub-group Outputs (Behringer Mixer) 3	Amiga 2000 L
8	Sub-group Outputs (Behringer Mixer) 4	Amiga 2000 R
9	DVD Record	1L Returns / Aux Inputs (Behringer Mixer)
10	DVD Record	1R Returns / Aux Inputs (Behringer Mixer)
11	Alesis Quadraverb2 L	2L Returns / Aux Inputs (Behringer Mixer)
12	Alesis Quadraverb2 R	2R Returns / Aux Inputs (Behringer Mixer)
13	Amiga 2000 L	3L Returns / Aux Inputs (Behringer Mixer)
14	Amiga 2000 R	3R Returns / Aux Inputs (Behringer Mixer)
15	Frequency Equalizer L	4L Returns / Aux Inputs (Behringer Mixer)
16	Frequency Equalizer R	4R Returns / Aux Inputs (Behringer Mixer)
17	3/4" Record L	DVD Record L
18	3/4" Record R	DVD Record R
19	Behringer Mixer Out L	DV # 2 L
20	Behringer Mixer Out R	DV # 2 R
21		AUDIO AMPLIFIER "CD" In L
22		AUDIO AMPLIFIER "CD" In R
23	DV# 2 L	AUDIO AMPLIFIER "Video 2" L
24	DV# 2 R	AUDIO AMPLIFIER "Video 2" R

SAMPLE AUDIO PATCH

Audio Patch Bay 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
OUT source	DV #1 L	DV #1 R	DV #3 L	DV #3 R	Mac G4-A Analog L	Mac G4-A Analog R	VHS # 1 L	VHS # 1 R	Canopus ADVC-100 L	Canopus ADVC-100 R	DVD/CD Player L	DVD/CD Player R	+/-5 V to audio lines 1	+/-5 V to audio lines 2	Mac G4-B Analog L	Mac G4-B Analog R	VHS # 2 L	VHS # 2 R	Audiotape Cassette L	Audiotape Cassette R	VHS # 3 L	VHS # 3 R	Korg MS20	Mirage Kbd
OUT	I	J	M	N	II	JJ			O	P	K	L	C	D							W	X	E	F
IN			EE	FF																			S	T
IN destination			Mac G4-A L	Mac G4-A R			Canopus ADVC-100 L	Canopus ADVC-100 R	Audiotape Cassette L	Audiotape Cassette R	Mac G4-B L	Mac G4-B R		Sippel Env Fol	Fairlight audiotrigger #1	Fairlight audiotrigger #2	DV # 1 L	DV # 1 R	Frequency Equalizer L	Frequency Equalizer R	DV # 3 L	DV # 3 R	VHS # 3 L	VHS # 3 R

Audio Patch Bay 2

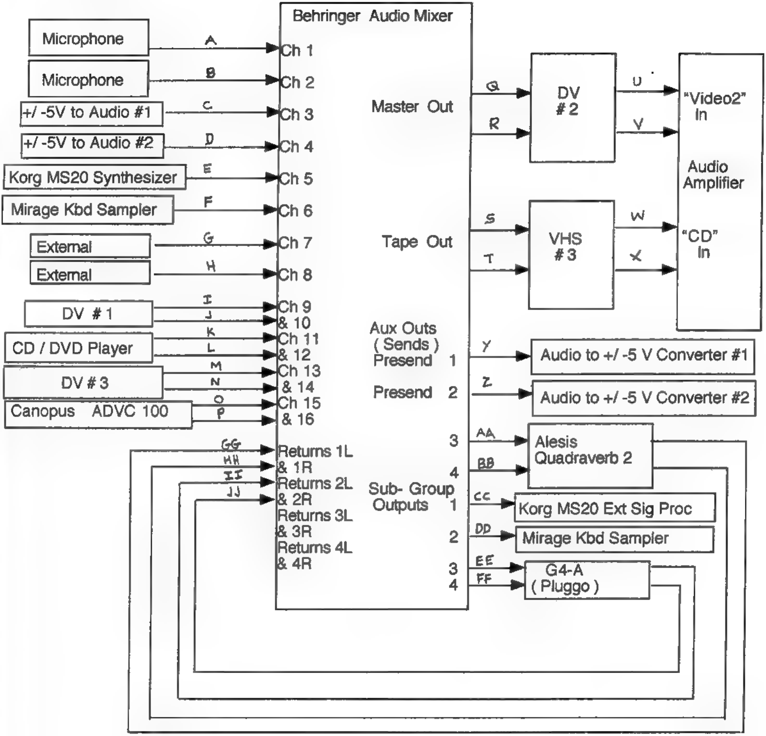
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
OUT source	Sends / Aux Outputs (Behringer Mixer) 1	2	3	4	Sub-group Outputs (Behringer Mixer) 1	2	3	4	DVD Record		Alesis Quadraverb2 L	Alesis Quadraverb2 R	Amiga 2000 L	Amiga 2000 R	Frequency Equalizer L	Frequency Equalizer R	3/4" Record L	3/4" Record R	Behringer Mixer Out L	Behringer Mixer Out R			DV# 2 L	DV# 2 R
OUT	Y	Z	AA	BB	CC	DD	EE	FF			GG	HH							Q	R			U	V
IN	AA	BB	Y	Z	DD	CC			GG	HH	II	JJ							Q	R	W	X	U	V
IN destination	Alesis Quadraverb2 L	Alesis Quadraverb2 R	Audio to +/-5 V 1	Audio to +/-5 V 2	MIRAGE KBD SAMPLER	Korg MS20 ESP	Amiga 2000 L	Amiga 2000 R	1L	1R	2L	2R	3L	3R	4L	4R	DVD Record L	DVD Record R	DV # 2 L	DV # 2 R	AUDIO "CD" In L	AUDIO "CD" In R	AMPLIFIER "Video 2" L	AMPLIFIER "Video 2" R

Returns / Aux Inputs (Behringer Mixer)

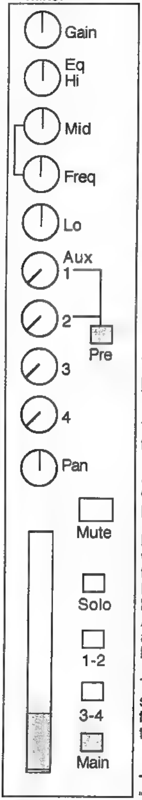
Front Panel Behringer Mixer

Ch 1	Ch 2	Ch 3	Ch 4	Ch 5	Ch 6	Ch 7	Ch 8	Ch 9&10	Ch 11&12	Ch 13&14	Ch 15&16
A (XLR)	B (XLR)	C	D	E	F	G	H	I	K	M	O
								J	L	N	P

SAMPLE AUDIO PATCH



Single Channel of Behringer Mixer



Default settings

Behringer UB2442 Mixer:

Connect audio sources directly to the **mixer's inputs (channels 1- 16)** on the Behringer UB2442's front panel. Sources can be :

1. from the outputs of the patch bay (e.g. DV #1, DVD/CD Player, G4 analog audio) into the mixer's line inputs using 1/ 4" cables.
2. from external devices (e.g. your miniDV camcorder , minidisc recorder, guitar) into the mixer's line inputs using 1/4" cables or adaptors .
3. from microphones into the mixer's mic inputs (channels 1-12) using XLR connectors.

For microphone inputs, the channel's gain trimpots should be turned fully clockwise.
For line inputs, the channel's gain trimpopts start straight up, and are then fine-tuned.

To send an individual channel to the main outputs, check that the "Main" switch is down (on) for that channel, and that the main mix fader bar is up as well as the indivudual fader bar for that channel..

The Behringer's **main mix outputs** are accessible from the patch bay.

Solo and mute switches should all be up and their LED's off.

Using the **aux sends** and **sub-groups**,the mixer also acts as an extension of the audio routing system , allowing you to split signals and send them to several destination points (e.g. the +/ -5V system, the G4, Quadraveb 2).

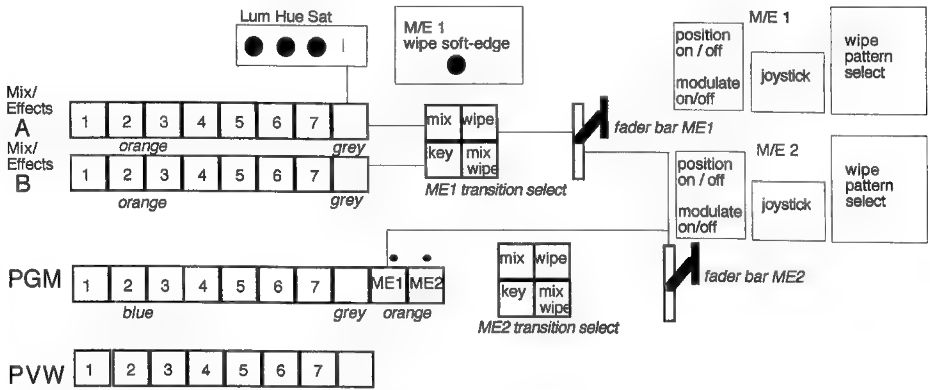
The mixer's **aux send (1-4) , sub-group (1-4) outputs** are accessible from the patch bay..
The mixer's **aux return (1-4 stereo) inputs** are also accessible from the patch bay.

There is a gain pot for each aux send on the individual channels as well as a master gain for each aux send near the upper right-hand corner of the mixer.

Aux sends 1 and 2 have a **prefade** option. If the "pre" switch is down (on) for a given channel , that channel's aux send pot operates independently of the channel's fader bar position.
If ,for example, you wanted to process a microphone's signal through the Quadraverb 2, but did not want any of the original unprocessed or "dry" microphone in the mix, you would use the prefade option and route aux sends 1 and 2 to the left and right channels of the Q2. Send the Q2's ouput back to the returns (or two other channels) of the mixer. Leave the mic channel's fader bar down, adjust the aux send pots for that channel and have the Q2's channel fader bars up.
Aux sends 3 and 4 are always in **postfade** mode, Both the channel fader bar and the aux send pot must be up to route the signal to the aux send's output. There will always be a mix between the dry, unprocessed signal and the processed one.

To send an individual channel to a sub-group's outputs, check that one of the sub-group switches(1-2 or 3-4) is down (on) for that channel, and that the corresponding sub-group fader bars are up. A channel can be sent to a sub-group out and the main channel out at the same time, or to just one of these outputs.

To monitor the main mix out on both the the level meters and headphones, check that the " main mix" switch (to the left of the headphone pot and meters) is on .You can also monitor sub-group outputs here.



Crosspoint Latch Switcher Front Panel Diagram:

Channels 1 through 7 are selected at the matrix .

The grey pushbutton can generate either black or a solid field of color depending on the switch above it. When the switch is set to "color", the knobs next to it adjust the luminance, hue and saturation of the color.

To view individual video signals at the switcher's output, select the signal's channel number on the Program (blue) bus.

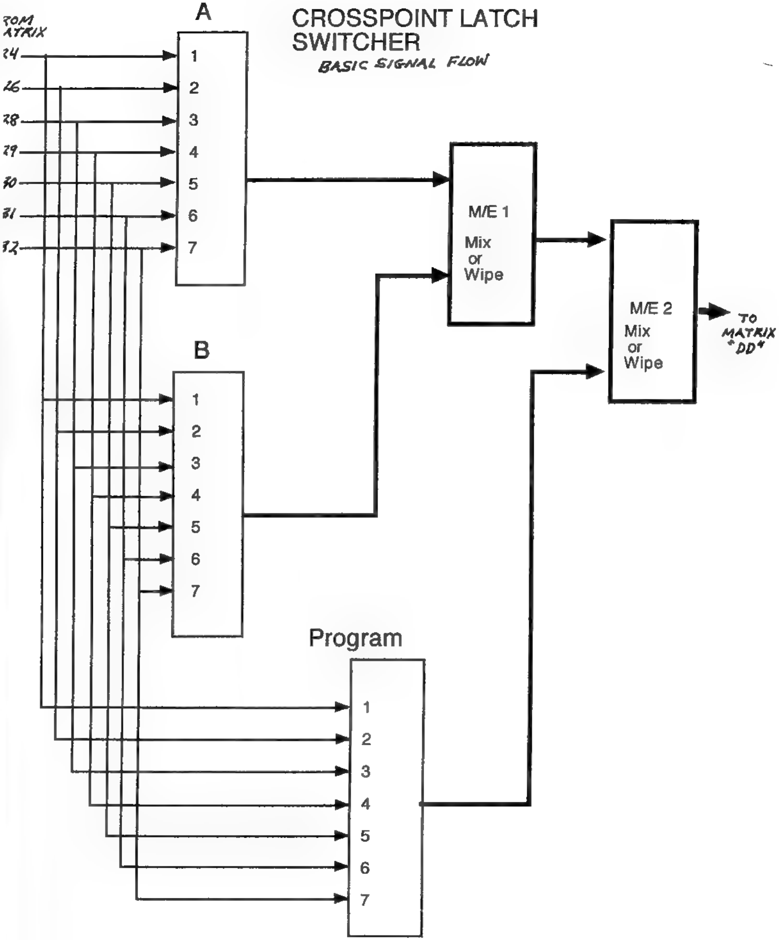
To mix or wipe between two video signals, select one video signal's channel number on the Mix/Effects A (orange) bus and another channel number on the Mix/Effect B (orange) bus. Then SELECT THE "ME1" PUSHBUTTON ON THE PROGRAM BUS so that the light above "ME1" is on. Select a transition (mix or wipe) on the ME1 (top) transition select. If "Mix" is selected the ME1(top) fader bar will determine the additive mix between bussesA and B. If "Wipe" is selected , the ME1 (top right) wipe pattern select will determine the shape between busses A and B and the fader bar will determine the size of the shape or split screen. If the position switch is off, certain shapes (e.g. circles and squares) will be centered automatically. If the positon switch is on , the joystick will position the shape on the screen.

To mix or wipe between the composite image from ME1 and a third video signal, select the third signal's channel number on the Program (blue) bus and select the orange "ME2" pushbutton on the same bus simultaneously so that the light above it is on. Then select "Mix" or "Wipe" from the ME2 (bottom) transition select. There are seperate fader bars, wipe pattern selects, and other controls for ME2.

If neither "ME1" nor "ME2" is selected on the Program bus, the switcher will only show an individual video signal (selected from the Program bus) at its output.

CROSSPOINT LATCH SWITCHER

BASIC SIGNAL FLOW



JONES (LUMINANCE) KEYERS 1 AND 2:

Internal Keying (Two Inputs)

Monitoring the Individual Signals:

1. Select video signals (e.g. TBC's, cameras) for Keyer input channels **A** and **B.**
2. Send the output of the Keyer to the Output Amp to monitor the signal.
3. Set the KEY ON / OFF switch on the Keyer's front panel to the down or OFF position.
4. Set the KEY NORMAL / REVERSE switch on the Keyer's front panel to the up or NORMAL position. This setting will show only the video signal being sent to Channel A.
5. Adjust Channel A's GAIN and PEDESTAL knobs using both Video Monitor # 1 and the Waveform Monitor as a reference.
6. Set the KEY NORMAL / REVERSE switch to the down or REVERSE position. This will show only the video signal being sent to Channel B.
7. Adjust Channel B's GAIN and PEDESTAL knobs using both Video Monitor #1 and the Waveform Monitor as a reference.

Setting the Key:

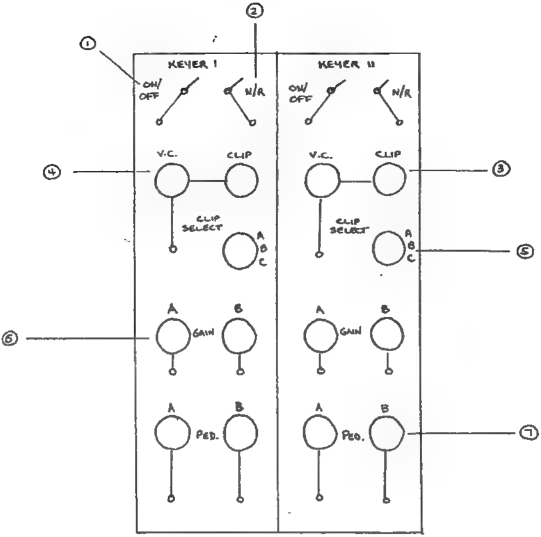
8. Set the KEY ON / OFF switch to the up or ON position.
9. Set the three-position CLIP SELECT switch to either A or B. This determines whether the video input signal for Channel A or Channel B is the clip input or cut-out shape.
10. Set the KEY NORMAL / REVERSE switch according to whether you want the dark or light areas of the clip input signal removed to reveal the other signal.
    For "Internal " keying (two images) , there are four possible configurations:
    Channel A as the clip input in key normal
    Channel A as the clip input in key reverse
    Channel B as the clip input in key normal
    Channel B as the clip input in key reverse
11. Adjust the CLIP LEVEL knob to control how much of Channel A or Channel B's signal you want.
    The clip level selects the shade of gray of the clip input video signal that will be the "cut-off" point , allowing the second video signal to fill in the gray areas either below or above that cut-off point.
12. You can then fine tune the GAIN and PEDESTAL settings for each channel.

External Keying (Three Input):

Steps 1 through 8 are the same.
When using a third video signal for the clip input, send that video signal to Channel C of the Keyer by selecting it on the matrix and then set the CLIP SELECT switch for C.
Channel C's input video signal is never seen with all of its gray levels. It functions as a "stencil". By adjusting the CLIP LEVEL knob, this third video signal defines the areas in which either Channel A's or Channel B's video signals are seen, placing them in mutually exclusive parts of the screen. The KEY NORMAL / REVERSE switch will reverse the positions of Channel A and B's video signals relative to the (third) clip input video signal.

Using A Color Kill with the Clip Input :

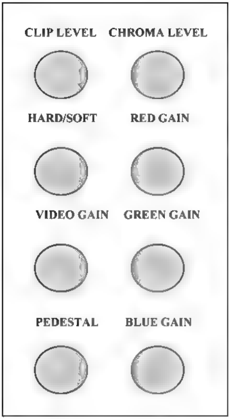
When using a color signal as the clip input, additional colors may result as you adjust the CLIP LEVEL knob. If you want to avoid this, the color kill devices can be patched before the signal reaches the clip input. For example, if you are keying between two color signals, keep those two signals connected to Channels A and B of the Keyer. In addition, send whatever video signal you want to use as a cut-out shape to one of the Color Kills on the matrix. Send the output of that Color Kill to Channel C of the keyer. When you set the CLIP SELECT switch to C, the additional colors will be gone.



1. On/Off switch: use or by-pass the clip
2. Normal/Reverse switch: type of keying
3. Clip level control
4. Voltage control input and range adjustment for clip
5. Three-position clip select switch
6. Gain controls for Channels A and B
7. Pedestal controls for Channels A and B

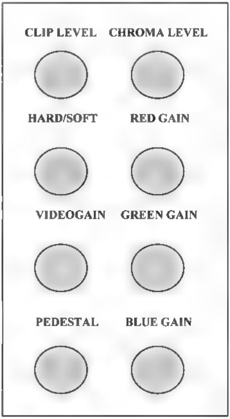
Jones Keyer Front Panel

COLORIZER/MIXER SET-UP
A. ADJUSTING LEVELS FOR THE INCOMING VIDEO SIGNAL

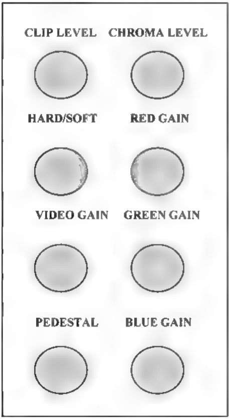


- Set the ON/OFF Switches for each of the six channels to the up or OFF position
- Send a video signal to Colorizer input Channel 1 on the Matrix.
- Send the output of the Colorizer to the Output Amp
- Set the ON/OFF switch for Channel 1 to the down or ON position
- Turn the CLIP, CHROMA LEVEL, RED GAIN, BLUE GAIN AND GREEN GAIN knobs completely to the left.
- Turn the HARD/SOFT CLIP knob completely to the right.
- Turn the VIDEO GAIN knob at around 12 o'clock or straight up.
- Adjust the PEDESTAL knob ,using both Video Monitor # 1 and the Waveform Monitor as a reference. Often the best range for the pedestal is somewhere between 12 o'clock and 4 o'clock, as anything to the left of this range may be all black, and anything to the right may be all white.
- Readjust the VIDEO GAIN knob slightly as needed.

ADDING COLOR TO THE VIDEO SIGNAL



- Select a color. Turn the CHROMA LEVEL knob straight up at 12 o'clock.
- Turn the RED GAIN knob up. Adjust the CHROMA PHASE knob on the system's Output Amp until the Vectorscope registers the signal in the "R" area. As with all hues in the system, the R,G and B signals of the Colorizer are relative to the Output Amp's CHROMA PHASE settings. Whatever the CHROMA PHASE setting is, these three knobs should represent points 120 degrees apart on the Vectorscope.
- Turn down the RED GAIN knob and adjust the four color knobs (Chroma level for saturation, plus R,G, and B gain controls) for the desired color. The combination of any two of the R, G, and B knobs should give the secondary colors of Cyan, Yellow and Magenta. The example to the right is magenta. Turning up all three knobs may cancel each other out leaving no saturation. The PEDESTAL knob will control the brightness of the color. This color mixes with the input video signal, tinting the entire image that color.



SETTING THE LUMINANCE KEYER

- Set the CLIP SELECT switch for channel 1 to "1".(There are six of these clip select switches at the lower right corner of the Colorizer's front panel. Each of these are six- position switches.)
- Slowly turn Channel 1's CLIP LEVEL knob clockwise. On the Colorizer's odd-numbered channels (1, 3, and 5), the CLIP LEVEL knob will begin taking out the brightest areas of the input video signal, leaving black in its place , and leaving the darkest areas of the video signal colorized. As you turn the knob, the remaining colorized area of the signal may darken, but you can readjust this with the PEDESTAL knob. On the Colorizer's even-numbered channels (2, 4, and 6), the CLIP LEVEL knob will begin taking out the darkest areas of the channel's input video signals , leaving black in its place and leaving the brightest areas of the video signal colorized. As you turn the knob, the remaining colorized areas of the signal may lighten, but you can adjust this with the channel's PEDESTAL knob.

COLORIZER / MIXER SET-UP continued

SETTING TWO COLORS FOR ONE VIDEO SIGNAL

- To set up the next channel, turn Channel 1's ON / OFF switch to the OFF position and turn Channel 2's switch ON.
- Send the same video signal to Colorizer input channel 2 (Matrix point # 34.) Repeat the procedure for adjusting GAIN and PEDESTAL levels, adding color and setting up the luminance keyer. The only difference now is that this keyer will black out the darkest portions of the image, leaving the rest colorized.
- Turn Channel 1 on again.
- Readjust the CLIP LEVEL knobs for each channel as needed. Because the luminance keying circuitry of the odd and even channels alternate the areas of the video signal that are blackened and colorized., adjusting the CLIP LEVELS of the two channels with this patch will allow you to have two separately controllable colors in opposite gray areas of the video image. If both CLIP LEVEL knobs are too far to the left, the two colors from each channel may wash each other out. If the CLIP LEVEL knobs are too far to the right, there may be too much black in the image. After the desired mix between the two channels is established, you may need to readjust the individual PEDESTAL levels again.

MIXING DIFFERENT VIDEO SIGNALS

- If you chose two different video signals for any two channels of the colorizer, the video signals, and their assigned colors will mix together. The brightest areas of each video signal will come through, with the channels' individual PEDESTAL controls determining the relative strength of each signal. The colors of each channel will combine according to the logic of additive color mixing. For example red from one channel and green from another channel will add up to yellow at the areas of the screen that they are superimposed. Each video signal that you add to each channel will combine at the Colorizer's output, provided that those channels are turned on and the PEDESTAL levels are set accordingly. Often the PEDESTAL knobs for each channel have to be slightly lowered with the introduction of a new channel to the mix. Only leave the ON / OFF switches turned ON for the channels that you are using.

OTHER VARIATIONS TO THE COLORIZER

- There is MASTER GAIN and PEDESTAL control for its output. These are usually left straight up at 12 o'clock but can be used to adjust the overall luminance values of the Colorizer. Please set them back to 12 o'clock for the next person using the Colorizer.
- There is a separate POLARITY SWITCH for each channel to render the input video signal positive or negative, reversing the gray values. Some pedestal adjustment may be required for each setting . Using these will help in getting more than two colors from a single image source. For example, if you have the same signal going into Channels 1 through 4, you can use the luminance keyers on each channel to separate the grey levels if: Channel 1 is positive (keys out white), Channel 2 is positive (keys out black), Channel 3 is negative (keys out white) and Channel 4 is negative (keys out black). Adjustments of the CLIP LEVEL knobs for each of the channels is important in this patch.
- There are separate CLIP INPUT SELECT switches for each channel . When first using the Colorizer, start with these switches in their default settings (i.e. channel 1 on "1", channel 2 on "2', 3 on "3", etc.) If you do experiment with them , turn them back to their default settings for the next person using the Colorizer. While the luminance keying circuitry in each channel always keys between the (colorized) input video signal and black, these CLIP SELECT SWITCHES allow a separate signal routed from another channel to be used as the cut-out shape, resulting in more complex ways of combining the signals.
- There is also a way to have additive mixing of the channels on the Colorizer. For this you have to set the LAYERED/ ADDITIVE SWITCH to ADDITIVE, and have ALL of the channels of the Colorizer turned on and ALL of the PEDESTAL knobs turned partially up. Again, if you experiment with this one, please set the switch back to LAYERED when you're done. This is the setting used in almost all applications of the Colorizer.
- All of the Colorizer's parameters except POLARITY , LAYERED/ ADDITIVE and CLIP INPUT SELECT are voltage-controllable.

EIGHT CHANNEL SEQUENCER

Initial Set-up:

1. Send video signals to the individual channels (0-7) of the Sequencer through the matrix.
2. Send the output of the Sequencer to the Output Amp .
3. On the Sequencer's front panel, set the MASTER PEDESTAL knob straight up at 12 o'clock.
4. Set the four-position SYNC MODE SWITCH to " 1 ".

To Monitor and Adjust the Pedestal Levels for Each Channel:

1. Set the SEQUENCE / SWITCH control to the down or SWITCH position.
2. Set the BINARY / SWITCHER control to the down or SWITCHER position for manual switching.
3. In the manual switching mode, the red push-button for each channel will light up that channel's LED and will show the individual video signal at the output amp
4. Adjust the individual PEDESTAL knob for that channel using both the Waveform Monitor and Video Monitor # 1 as a reference.

The Sequence Mode:

1. Set the SEQUENCE / SWITCH control to the up or SEQUENCE position.
2. Set the COUNT BIAS knob and SYNC BIAS knob straight up at 12 o'clock.
3 Send a **PULSE** wave from the +/ - 5 V system to the COUNT INPUT jack of the sequencer.
   This could be a square wave output from one of the oscillators (but not a sine or triangle output)
   or a signal with a continuous waveform processed through one of the comparators
   or a random pulse from the random signal generators
   or the trigger output of the Korg MS 20 External Signal Processor
4. In the SEQUENCE mode, the device will always step through the video signals in the order that they were sent to the matrix starting with channel 0. The rate of the sequence will be determined by the frequency of the incoming +/- 5 v signal (for example, the frequency range switch and fine tuning knob on the oscillator). The last channel stepped in the sequence will be determined by the red push-button for that channel.

Sync Modes:

Sync Mode 0 : does NOT allow for vertical interval switching (there will be a visible glitch at the switch point.) It does allow for switching faster than the field rate if the incoming +/- 5 v pulse signal is above 60 cycles.

Sync Mode 1: **This is the most commonly used mode.** It does allow for vertical interval switching at he frequency of the incoming +/ -5 v signal.

Sync Mode 2: Also allows for vertical interval switching at half of the rate of the incoming +/- 5 v signal.

Sync Mode 3: Always switches at the field rate of 60 cycles (or at whatever the frequency of the signal is that is patched into the SYNC INPUT jack. This signal is almost always vertical drive from the Sync Generator). This mode ignores the signal going to the count input.

Switch Mode Logic:

When the SEQUENCE / SWITCH control is in the up or SEQUENCE position:

- The device is always in the sequence mode and needs a +/ - 5 v **PULSE** signal to the count input
- The BINARY / SWITCHER control is disabled

When the SEQUENCE / SWITCH control is in the down or SWITCH position:

- The BINARY / SWITCH control is enabled, allowing a choice between binary control and manual switching.

- The count input will be disabled.

Binary Control:

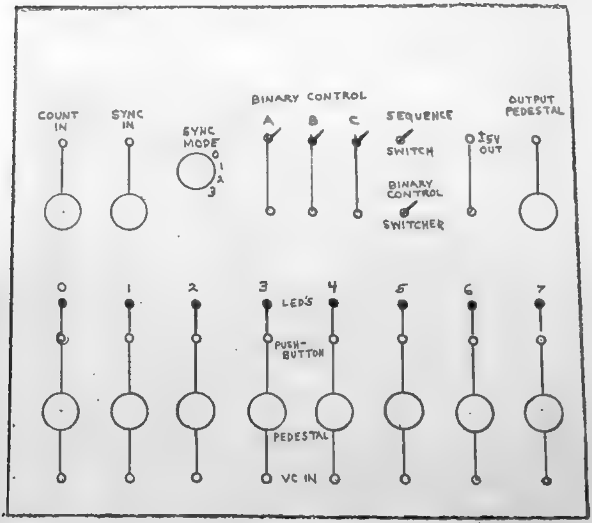
The BINARY CONTROL mode uses the combination of the A, B and C SWITCHES and control voltage inputs to select an individual channel through binary logic

- When all three switches are down, channel 0 is on
- When A and B are down and C is up, channel 1 is on
- When A is down, B is up and C is down, channel 2 is on
- When A is down, and B and C are up, channel 3 is on.
- When A is up, and B and C are down, channel 4 is on
- When A is up, B is down and C is up, channel 5 is on.
- When A and B are up and C is down, channel 6 is on.
- When all three switches are up, Channel 7 is on.

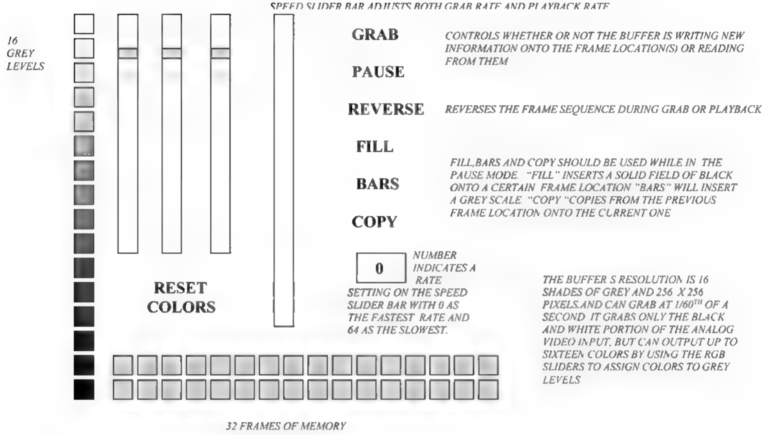
Memorizing binary logic is less important than understanding that when asynchronous control voltages are sent to the A, B and C input jacks, it allows for a more undetermined ordering of images, as opposed to the constant linearity (0,1,2,3…) of the sequence mode.

The A, B, or C inputs can take either a pulse or continuous +/ - 5 v signal

The switch must be up for the corresponding input jack in order for the incoming control voltage to work.



DESIGNLAB FRAME BUFFER (FB-1)
BUFPALLETTE MENU



INITIAL SET-UP

1. Put the KICKSTART disk into the Amiga 1000 Computer's disk drive.
2. When the WORKBENCH prompt appears on the Amiga's monitor, put in the BUFPALLETTE disk.
3. Double click on the BUFPALLETTE disk icon.
4. Double click on the BUFPALLETTE program icon.
5. In the BUFPALLETTE program, select under OPTIONS and FRAMES, "32".
6. Send a video signal to the Frame Buffer's (FB-1) video input .
7. Send the Frame Buffer's (FB-1) black and white output to the Output Amp.
8. On the BUFPALLETTE program menu, click the word GRAB until it is highlighted with a blue rectangle At this point , the digitized video signal should be seen through the Output Amp.
9. Set the SPEED SLIDER BAR to the top setting.
10. On the front panel of the Frame Buffer, adjust the BRIGHTNESS and CONTRAST knobs using both the Waveform Monitor and Color Monitor #1 as a reference.

BASIC FUNCTIONS

There are four basic variations to grabbing (writing) and playing back (reading) video information with the buffer

1. Grab is on	Pause is off	The buffer will continuously write new information from the incoming digitized video signal to the 32 frame locations at a rate determined by the SPEED SLIDER BAR. The top speed is one sixtieth of a second. As it loops through the 32 frames, it will continuously erase the old information that was in the frame location and update it with a new image.
2. Grab is off	Pause is off	The buffer will read or play back the last 32 frames in memory at a rate determined by the SPEED SLIDER BAR.
3. Grab is off	Pause is on	The buffer will read one frame at a time and hold it at the output until another frame location icon is clicked. You can randomly access any of the 32 frames
4. Grab is on	Pause is on	The buffer will grab or write one frame at a time. To do this: Click on one of the 32 frame location icons where you want to hold the image. Put the speed slider bar in the top position .As soon as you see the image that you want , one of two methods can be used:

- Deselect GRAB. You can see the single frame that you've just grabbed
  Go to the next frame location that you want to write on
  Select GRAB and repeat this process

  or

- Staying in GRAB, click to the next frame location. You won't see the still image that you've just grabbed until later.

With either method, when you're done selecting and grabbing the frame sequence that you want, **Deselect GRAB and then deselect PAUSE** to play back the sequence.
If you deselect PAUSE first, you will inadvertently erase your sequence.
Adjust the SPEED SLIDER BAR for the playback rate.

SELECTIVE STORAGE WITH THE BUFFER'S LUMINANCE KEYER

The buffer has a built-in luminance keyer and a separate video clip input on the matrix, but rather than keying between two different incoming video signals as in a conventional keyer, the buffer is keying between different data. That data is either in the form of old information that has already been written into the buffer's memory or new information that it is currently writing into memory.
When the Buffer's KEY ON / OFF SWITCH is down or in the OFF position, the keyer is disabled. The buffer is then either grabbing(writing) a full frame or playing back (reading) a full frame of video information at any given time. With the KEY ON / OFF SWITCH in the up position and a video signal sent to the FB-1 clip input , it is capable of writing, or updating a selected portion , or so many pixels of a frame location. This selection is determined by: 1. the grey levels of the clip input's video signal, 2. whether the front panel's KEY NORMAL / REVERSE switch is up or down, and 3. the setting on the CLIP LEVEL knob. .In all cases, the buffer is always writing information *from* the main input's video signal , but only onto specific areas of the frame location designated by the clip input's video signal. There can be several variables to this process. Among them:

Grab On	Pause On	Key Normal	The buffer will continuously update video information onto areas of a single frame location designated by the darkest portions of the clip input's video signal.
Grab On	Pause On	Key Reverse	The buffer will continuously update video information onto areas of a single frame location designated by the lightest portions of the clip input's video signal.
Grab On	Pause Off	Key Normal	The buffer will continuously update video information onto areas of each successive frame location designated by the darkest portions of the clip input's video signal at a rate determined by the "Speed" slider bar.
Grab On	Pause Off	Key Reverse	The buffer will continuously update video information onto areas of each successive frame location designated by the darkest portions of the clip input's video signal at a rate determined by the "Speed" slider bar.

Another important variable is whether or not there are two different video signals going into the video and clip inputs or the same video signal.

COLOR MAPPING:

There are two outputs to the buffer. "FB-1 Black and White" will always be monochromatic and have a somewhat sharper signal. "FB-1 Color Map " will show different hues and saturation values for each grey level as they are assigned with the R G B slider bars in the Bufpallette program menu.

16- color palettes can be composed in Deluxe Paint using the color spread , copy and exchange functions and imported to the buffer. In Deluxe Paint, save the file under "Save Picture" to an Amiga-formatted floppy disk and bring it into Bufpallette under the "Load Picture" selection. You can then grab new images with this palette.

Jitter Inputs and Outputs in the ETC System

This is the simplest path :

DV Camcorder or VTR → G4 (Firewire In / Radeon Analog Video Out) → svideo switcher 4 for TBC C → TBC C svideo in → DV #3 svideo in

If your source material is already on mini-DV, then the most direct input is a 4-6 pin firewire connection to the G4. But any analog source can be used as an input

The shaded area is pre-patched:
The Radeon card's svideo output always goes to input 4 of the black svideo switcher box , and then to the svideo input of TBC C. In the TBC menu, make sure that "svideo" is the selected input (Select " TBC 1", select "PREFS" , then select " SVIDEO" . "COMPOSITE" is for sending an input from the video patch bays to TBC C). The svideo output of TBC C always goes to DV #3. Check that the input select switch on the front of DV #3 is set for "svideo". This is the most direct recording. Monitor DV#3's output.

TBC C — Composite Video Outputs → Video Patch Bays
TBC C — Composite Video Outputs → Video Matrix Switcher

ALTERNATIVE OUTPUT
The composite output of TBC C always goes to both the video patch bays and the matrix. The output of Jitter can then be sent to any analog device.(e.g. the Colorizer, or Wobulator)at the matrix, and then through the Output Amp for recording.

ALTERNATIVE INPUTS
Using the video patch bays, any analog video source (e.g.VHS, Hi-8, or the Output Amp) can be sent to the input of the Canopus converter.On the Canopus box, set the input for "analog in". Use either a 6-6 pin or 4-6 pin firewire cable to connect between the Canopus and the G4. Disconnect any other video firewire devices, such as a camcorder or DV deck from the G4.

Video Patch Bays → Canopus ADVC-100 Analog-DV Converter → G4 (Firewire In / Radeon Analog Video Out)

If you want to have ETC analog devices going both to **and** from Jitter:
Use matrix spare ouputs #19 or 20 to send analog signals to the patch bay, and then to the Canopus. Use the composite output of TBC C to send Jitter back to devices at the matrix. Use the Output Amp as the final record out.

If you are using the ETC 2003 patch, **test the firewire input** :
1. Double-click on the " p FIREWIREinput" object
2. Click "getdevlist". "DVvideo" should appear under "prepend append".
3. Click "open'
4. Click the toggle above "metro 2" object , so that an x appears.
The live firewire image should appear in the small window.
Once you have this, you can test the output of Jitter

To **test the output of Jitter** in the ETC 2003 patch:
1. Select Apple E to unlock the patcher
2. Drag the the "p FIREWIREinput" object to the white work area.
3. Connect the (bottom left) outlet of the object to the (top left) inlet of the " jit matrix 4 char 320 240" object.
4.Press Esc on the keyboard . The image should be full screen on the computer monitor.
5.Press ESC again. The monitor will return to the ETC patch, with a small floating window of the image.
6. Drag this window to the right of the desktop and off the screen until it appears at the output of TBC C.
7. Select ESC again. This is the video output for Jitter.

+/- 5 VOLT ANALOG SYSTEM

APPLICATIONS :

1. as control voltages to any of the following video devices:
   Colorizer/Mixer (Gain, Pedestal, Clip Level, Chroma Level, Red, Green, Blue Mix)
   Paik-Abe Raster Scan (H,V and S inputs)
   Luminance Keyers (Gain, Pedestal, Clip Level, Key On/Off, Key Normal/Reverse)
   Designlab Frame Buffer (Gain, Pedestal and Clip Level)
   Mixer (Gain/Polarity)
   Eight-Channel Sequencer (Count, Individual Channel Pedestals, Master Pedestal)
   Output Amplifier: Gain and Pedestal
2. as audio signals via the [+/-5V to audio line converters], which send the signals to the audio patch bay
3. as video signals via the [+/- 5V to video line converters] which send the signals to the video matrix
4. as signal sources and control voltages to other +/- 5 volt modules
5. as MIDI data via the J.L. Cooper Fader Master

TYPES OF MODULES IN THE +/- 5V SYSTEM:

Signal Generators:		Voltage Controllable Oscillators, Positive and Negative Ramp Wave Generators, Triangle Wave Generators, Random Signal Generators (white noise, random pulse, random ramp etc.)
Signal Processors:		
	Changing gain:	Attenuators, Dual Voltage - Controllable Amplifier
	Changing polarity:	Inverters, Inverter X 2
	Changing waveshape:	Comparators, Voltage-Controllable Filter, Waveshaper
	Combining signals :	Mixers, Sample and Holds, Dual VCA,
	Splitting signals:	Multiples

PARAMETERS OF THE SIGNAL

A waveform is a graphic representation of an electronic signal with time represented in the horizontal axis and voltage in the vertical axis

Gain: the total voltage excursion or sweep from high to low. In audio this is often a function of amplitude and in video it is a function of grey levels. As a control voltage to a device, it determines how much of an effect the signal will have on the parameter it is applied to. Gain can be increased with an amplifier or reduced with an attenuator

Frequency: the number of times that a waveform completes one cycle from low voltage to high voltage and back in a finite period of time . The unit of time is usually one second,and "cycles per second" are expressed as "hertz". Control voltages are often referred to as " slow-varying", a general range from one cycle every couple of minutes to frequencies directly below the audio spectrum. Audible frequencies can be from 16 to 20,000 Hz. for humans with higher frequencies representing higher pitches. In video, the field rate (60 Hz.)is an important threshold frequency for it is at this point that changes in voltage are represented graphically by changes in gradations along the vertical axis, with frequencies at multiples of the field rate producing more horizontal bands on the raster. The next important threshold is the line rate or 15,750 Hz (a number derived from the multiplying the number of lines in a frame, 525, by he number of frames in a second,30).Above this frequency changes in voltage, or brightness take place within each scan line of video.

Waveshape the nature of the change in voltage with respect to time. There are two broad categories of waveshapes, *continuous* (including sine and triangle), which have gradual transitions between low and high voltages ;and *pulse* (including square) which jump instantly between high and low voltage, although some waveshapes, such as positive and negative ramp (or sawtooth) waves have characteristics of both types. As a control voltage , the waveshape will determine whether the change to the applied parameter will be gradual or immediate . As an audio signal , it will be represented by the timbre of the sound.

Signal Generators	APPLICATIONS OF + / 5 VOLT SIGNALS		
	As Slow-Varying Control Voltages	As Audio Signals	As Video Signals
FREQUENCY	the rate of change of the applied parameter often <60 HZ for control voltages to video devices often <20 HZ for control voltages to audio devices	Pitch Audio Frequency Range: ~20 Hz- 20 Khz an octave above a given tone is twice the frequency	>60 Hz (Field Rate) for generating horizontal shapes >15,750 Hz (Line Rate or 525 lines X 30 frames/sec) for generating vertical shapes
ROUTING	patch directly to the control voltage input of devices, using mini cables	patch to the +/-5v to audio converters (sends the signal to the audio patch bays, where it can be routed to the mixer and/ or any audio processor)	patch to the +/-5v to video converters (sends the signal to the matrix switcher where it can be routed to any video device)
GAIN	the overall sweep or range of effect on the applied video/ audio parameter; controlled by attenuators	the overall volume of the audio signal	the overall contrast of the video signal high voltage is white. low voltage is black
WAVESHAPE *Continuous (Sine, Triangle)*	the nature of change on the applied parameter with respect to time sine waves as control voltages result in the most gradual transitions in a parameter change, used for dissolves or fades	timbre, tone color Sine waves contain only the fundamental frequency, with no overtones, and form the building blocks for more complex sounds.	determines how the range of gray levels is spread across the horizontal or vertical axis a sine wave just above 60Hz will form a continuous range of gray levels from the top of the video raster to the bottom
Pulse	the most abrupt changes in a parameter, alternating between 2 discrete states, analogous to a switch	already a complex waveform with several harmonics, resulting in a richer tone.	a pulse wave just above 60 Hz will produce only two gray levels from the screen's top to bottom., resulting in hard-edged white and black horizontal bars
OTHER CONSIDERATIONS	**Bias** is the center point of the sweep, often determined by the potentiometer for the parameter being controlled (e.g. for a CV of a fixed gain, use the pedestal knob of the colorizer to control whether it sweeps from black to full video, or full video to white. **Vertical Interval Switching** A Sample & Hold patch may be used to clean up glitches that sometimes occur when using a CV on video devices. **Synchronizing Controls** the timing of control voltages can be coordinated w/ multiples, inverters, clock dividers &	**Additive Synthesis** Simple waveforms are combined for more complex sounds through mixers & the Dual VCA; also by frequency modulating oscillators with control voltages that are in the audio frequency range **Subtractive Synthesis** Complex waveforms are broken down usually through VC Filters by removing partials from their frequency spectrum **Envelope Generators** An envelope is a contour (shape) that is used to create some of the transient (changing) characteristics of the sound; usually expressed as Attack ,Decay, Sustain and Release (ADSR)	**Sync Inputs** The sync inputs on the oscillators are most likely to be used here. For signals >60Hz but<15.75 Khz, vertical drive is often patched to the sync input to synchronize the beginning of a field with one of the cycles (i. e. to make the bars stop rolling). For signals above the line rate, horizontal sync is most likely to be used to synchronize the beginning of each line with one of the cycles of the waveform.But free-floating oscillators and random signal generators are also used. **Complexity** 2 or more oscillators (usually one synced to vertical and one to horizontal)are often mixed together to form more complex shapes

+ / - 5 Volt System: Continuous and Pulse Waves

Continuous

Continuous waves include most waveforms that are not a pulse (or random) wave. They can be **symmetrical** (**sine** or **triangle** waves) or **asymmetrical** (**positive** and **negative ramp** waves, which are only continuous on one side.) Sine waves are the most continuous and simplest type of waveform, containing only the fundamental frequency, offering the smoothest transitions when used as a control voltage. Ramp waves allow either a gradual rise and sudden fall in voltage (positive) or sudden rise and gradual fall (negative). They can also be contours determined by other means (e.g. Envelope Followers , determined by fluctuating audio levels and Envelope Generators , determined by the parameters Attack, Decay, Sustain and Release.)

Sources of Continuous Waves
triangle and sine wave outs of Oscillators
Korg MS20 ESP: audio to envelope out
Ramp Wave Generators
signals through VC Filter and Waveshaper
Doepfer Envelope Follower
Envelope Generator of the Korg MS20
Doepfer Light to Voltage Source
Doepfer MIDI to CV out

Applications :parameters to modulate
gain of OA, Colorizer, Keyer, FB-1
pedestal of OA, Colorizer. Keyer, FB-1, Sequencer
key clip level of Keyer, Colorizer, FB-1
red,green,& blue gain, and chroma level of Colorizer
H,S & V control of Wobulator
frequency modulation of Oscillators
control of gain on VC Amplifier or VC Mixer
control of cut-off frequency on VC Filter
inputs to JL Cooper Fadermaster for MIDI

Ways of Processing/ Coordinating Signals
Multiples to split signal
Sample & Hold for stair-stepped voltage
Comparator to change to a pulse wave
Inverter to change polarity
Morph Controller for multiple delayed outputs
Mixing through basic or VC Mixers

Pulse

A **pulse wave** is any waveform that is either high voltage or low voltage with no stages in between.
The **pulse width** is the ratio of time that a pulse signal is high voltage to low voltage, sometimes referred to as its duty cycle.. A comparator can be used for pulse width modulation (PWM)
A **square** wave is a type of pulse wave that is symmetrical, or high voltage and low voltage, each 50% of the time .
The terms **trigger, gate** or **clock** are often used as applications of a pulse wave (for example, Envelope Generator trigger inputs, Envelope Follower trigger outputs, Sample and Hold clock inputs, Clock Divider etc.)

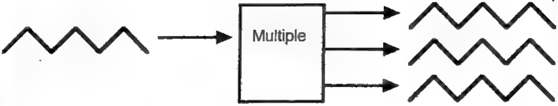
Sources of Pulse Waves
pulse out of the Ramp Wave Generators
Random Pulse Generator
square wave outputs of Oscillators
Korg MS20 Ext Signal Proc: audio to trigger out
signals through Comparators
clock out of the Doepfer MID to CV .

Applications
Key on/ off
Key normal/ reverse
Sequencer count in
Sequencer binary controls in
clock input to a Sample& Hold
step in to Random Sample & Hold
trigger input to Envelope Generators
trigger input to Ramp Wave Generators

Ways of Processing/ Coordinating Signals
Multiples to split signal
Clock Divider for multiple rhythmic pulse outputs
Morph Controller for multiple delayed outputs
Inverter to change polarity

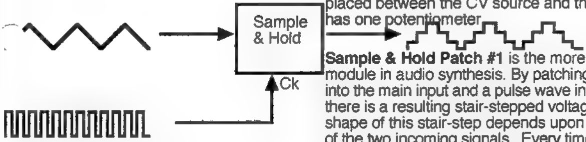
+/ -5V System: Basic All-Purpose Patches

An **Inverter** reverses the polarity of a signal so that its output is 180 degrees out of phase with its input. Using both the original and the inverted signals as control voltages is a basic patch for alternating between two events , such as cross-fading audio or video .It has no potentiometers.

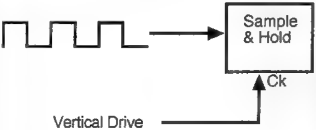


A **Multiple** simply splits a signal, in order to send it to several destination points. These are unlabelled and scattered throughout the +/-5V yellow panel modules, usually as 4 mini-jacks grouped together. Any one can be the input, and the other 3 are outputs.

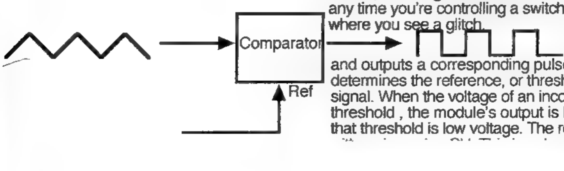
An **Attenuator** is the opposite of an amplifier and is essential for having any control over the range of an applied parameter. Since many CV sources, such as oscillators, may put out a much larger gain than you might want, this module can be placed between the CV source and the applied parameter.It has one potentiometer.



Sample & Hold Patch #1 is the more traditional use of the module in audio synthesis. By patching a continuous waveform into the main input and a pulse wave into the ck (clock) input, there is a resulting stair-stepped voltage at its output,. The shape of this stair-step depends upon the relative frequencies of the two incoming signals. Every time the pulse reaches high voltage it hold the voltage level of the main input signal until the next high voltage point in the pulse. The faster the pulse wave is relative to the main input signal, the more steps there are. This can be used for incremental controls of many parameters.

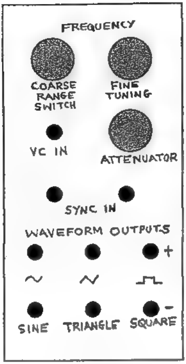


Sample & Hold Patch # 2 is specifically for controls of video devices to eliminate a horizontal glitch that is the result of the CV making abrupt changes that are not during the vertical blanking period of the video signal. Vertical Drive is coming from the video system's sync generator. Its output is marked "V" on the bottom yellow box.Patch this into the ck input.Patch the CV signal for the video parameter into the S&H's main input. Then patch the output of the S&H to the video parameter. Try this patch when using any of the following as CVs to video: pulse waves, the Korg MS20 ESP's envelope out, random signals , any time you're controlling a switch (e.g. key N/R)or any signal where you see a glitch.



A **Comparator** takes any continous wave at its input, and outputs a corresponding pulse wave The potentiometer determines the reference, or threshold point of the incoming signal. When the voltage of an incoming signal reaches that threshold , the module's output is high voltage. Anything below that threshold is low voltage. The reference can also be changed

VOLTAGE-CONTROLLABLE OSCILLATOR (1 of 8)



THE FREQUENCY OF THE WAVEFORM IS CONTROLLED BY A COMBINATION OF THE COARSE RANGE SWITCH AND FINE TUNING KNOB. THESE ALLOW FOR A COMPLETE RANGE OF APPLICATIONS, FROM VERY SLOW VARYING CONTROL VOLTAGE S OF LESS THAN A CYCLE PER MINUTE , THROUGH THE AUDIO SPECTRUM TO MULTIPLES OF THE VIDEO LINE RATE FOR PRODUCING SHAPES ON THE VIDEO RASTER.

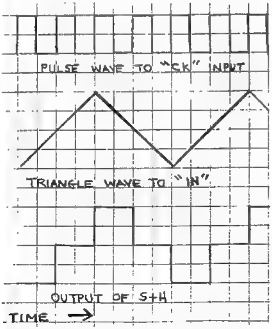
THE FREQUENCY OF THE WAVEFORM CAN BE MODULATED BY AN INCOMING CONTROL VOLTAGE FROM OTHER MODULES IN THE +/- 5 V SYSTEM. THE ATTENUATOR KNOB DETERMINES HOW MUCH OF AN EFFECT ON THE FREQUENCY THE INCOMING CONTROL VOLTAGE WILL HAVE.

THE SYNC INPUT ALLOWS FOR SYNCHRONIZING THE BEGINNING OF EACH CYCLE (OR EVERY SO MANY CYCLES) OF A WAVEFORM WITH OTHER TIMING STRUCTURES IN THE SYSTEM SUCH AS VERTICAL DRIVE ,HORIZONTAL DRIVE, OR A PULSE WAVE FROM ANOTHER MODULE

THERE ARE SIX OUTPUTS ON THE OSCILLATOR; THREE WAVESHAPES (SINE, TRIANGLE AND SQUARE) , EACH WAVESHAPE HAS A POSITIVE AND NEGATIVE OUTPUT, WHICH ARE ALWAYS 180 DEGREES OUT OF PHASE WITH ONE ANOTHER.

SAMPLE AND HOLDS

SAMPLE AND HOLDS COMPARE TWO SIGNALS, ONE AT THE CLOCK INPUT AND ONE AT THE MAIN INPUT AND PRODUCE A CORRESPONDING OUTPUT.
WHEN THE +/- 5 V SIGNAL BEING SENT TO THE "CK" INPUT IS AT HIGH VOLTAGE, IT WILL SAMPLE THE VOLTAGE LEVEL OF THE MAIN INPUT'S SIGNAL AND HOLD IT AT A STEADY LEVEL UNTIL THE NEXT HIGH VOLTAGE COMES INTO THE "CK" INPUT, WHEN IT WILL SAMPLE AND HOLD AGAIN. THERE ARE AT LEAST TWO APPLICATIONS OF THIS:

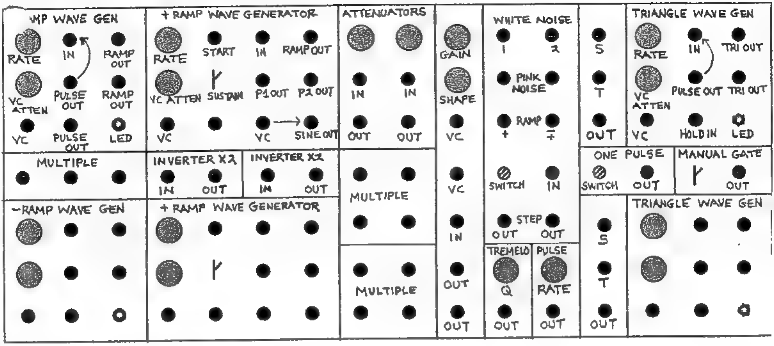


1. **A STAIR-STEPPED CONTROL VOLTAGE** WILL RESULT WHEN A CONTINUOUS (E.G. TRIANGLE OR SINE) WAVE IS SENT TO THE MAIN "IN" AND A PULSE (E.G. A SQUARE) WAVE IS SENT TO THE "CK" .

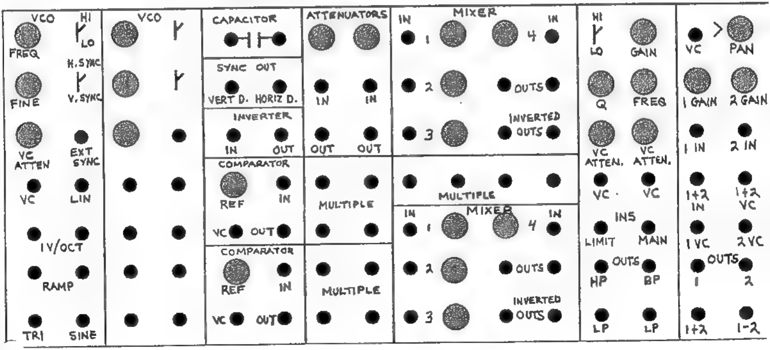
2. **VERTICAL INTERVAL SWITCHING WITH A CONTROL VOLTAGE**
IF A PULSE WAVE IS SENT TO THE CONTROL VOLTAGE INPUT OF A VIDEO DEVICE (SUCH AS A SQUARE WAVE TO THE COLORIZER'S PEDESTAL LEVEL) OR ANY WAVESHAPE IS SENT TO A CONTROL SWITCH (SUCH AS THE KEY NORMAL/REVERSE CONTROL ON KEYER 1), THERE WILL BE A VISIBLE "GLITCH""IN THE VIDEO SIGNAL WHEN THE CONTROL VOLTAGE CHANGES. THIS IS BECAUSE THE CHANGE IS NOT TAKING PLACE DURING THE VERTICAL BLANKING PERIOD.
SENDING THE CONTROL VOLTAGE TO THE MAIN "IN" OF THE SAMPLE AND HOLD FIRST WHILE SENDING VERTICAL DRIVE (FROM YELLOW BOX # 2) TO THE "CK" INPUT WILL RESULT IN AN OUTPUT THAT SWITCHES CLEANLY, OR IS SYNCHRONIZED WITH THE VERTICAL BLANKING PERIOD OF THE VIDEO SYSTEM.

THE SAMPLE AND HOLD MODULES ON YELLOW BOX # 1 OFTEN WORK IN CONJUNCTION WITH THE TRIANGLE WAVE GENERATORS TO THEIR RIGHT AND IS CONFIGURED SOMEWHAT DIFFERENTLY THAN THE ABOVE MODULE . THE PULSE IS SENT TO THE "S" INPUT AND ITS OUTPUT IS SENT TO THE "H" INPUT OF THE TRIANGLE WAVE GENERATOR.
THERE IS ALSO A RANDOM SAMPLE AND HOLD GENERATOR ON THE SAME BOX. WHEN A PULSE IS SENT TO IT, THE "STEP" OUTPUTS SEND A RANDOM VOLTAGE LEVEL WITH EACH PULSE SAMPLE.

NEGATIVE RAMP WAVE GENERATOR | POSSITIVE RAMP WAVE GENERATORS & INVERTERS X 2 | ATTENUATORS & MULTIPLES | WAVESHAPER | RANDOM SIGNAL GENERATORS | SAMPLE & HOLDS | TRIANGLE WAVE GENERATORS



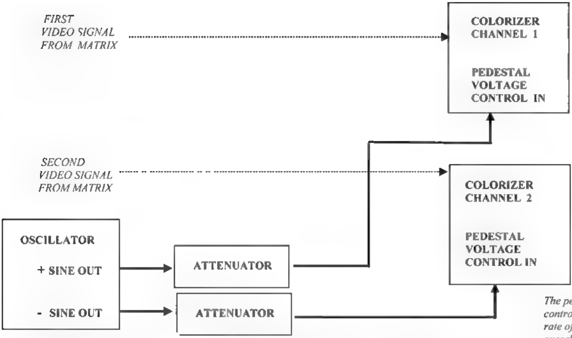
VOLTAGE-CONTROLLABLE OSCILLATORS | CAPACITOR, VERT ICAL & HOR IZ. DRIVE, INVERTER, COMPARATORS | ATTENUATORS & MULTIPLES | MIXERS & MULTIPLES | VOLTAGE-CONTROLLABLE FILTER | DUAL VOLTAGE-CONTROLLABLE AMPLIFIER



+ / - 5 VOLT ANALOG SYSTEM MODULES

SAMPLE +/- 5 V PATCH: USING THE COLORIZER AS A VOLTAGE-CONTROLLABLE MIXER.

VARIATION 1: CROSSFADING BETWEEN TWO VIDEO SIGNALS

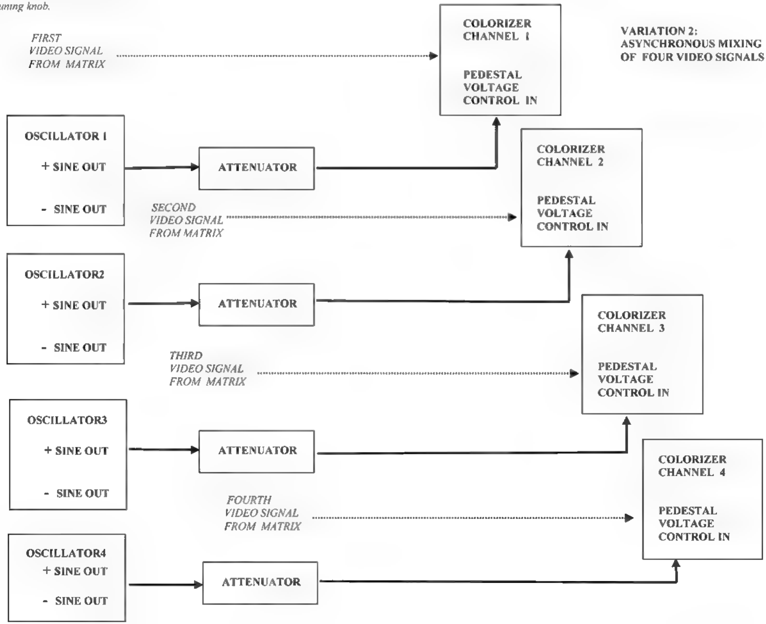


The two outputs from the oscillator are always 180 degrees out of phase.(+ out will be high voltage while the - out is low and vice-versa.) The rate of the control voltage is determined by the frequency range switch and fine tuning knob.

The signals coming from the oscillators are full gain. Sending them directly to the pedestal cv inputs would sweep the full range from black to white. The attenuators allow for a usable range , letting you control the gain of the control voltage

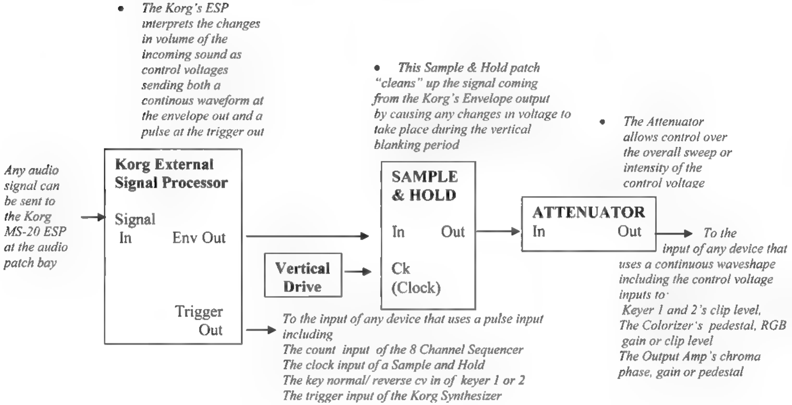
The pedestal knobs control the bias of the incoming control voltages. While the oscillators control the rate of the sweep, and the attenuators control the overall range, the bias determines the center point of the sweep. In this case, it will determine whether or not it sweeps the signal from black to full video, or from full video to white

VARIATION 2: ASYNCHRONOUS MIXING OF FOUR VIDEO SIGNALS

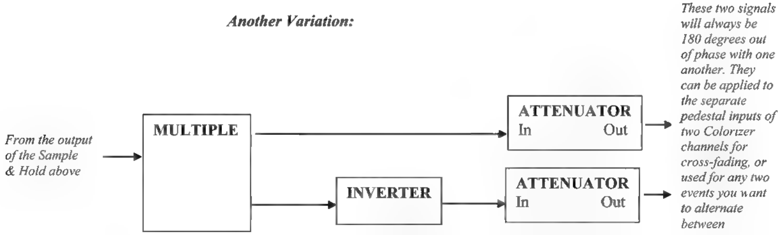


SAMPLE PATCHES FOR TURNING AN AUDIO SIGNAL INTO A CONTROL VOLTAGE

- *Vertical Drive, Sample & Holds , Attenuators , Multiples, and Inverters are all modules in the +/- 5 V Analog System*

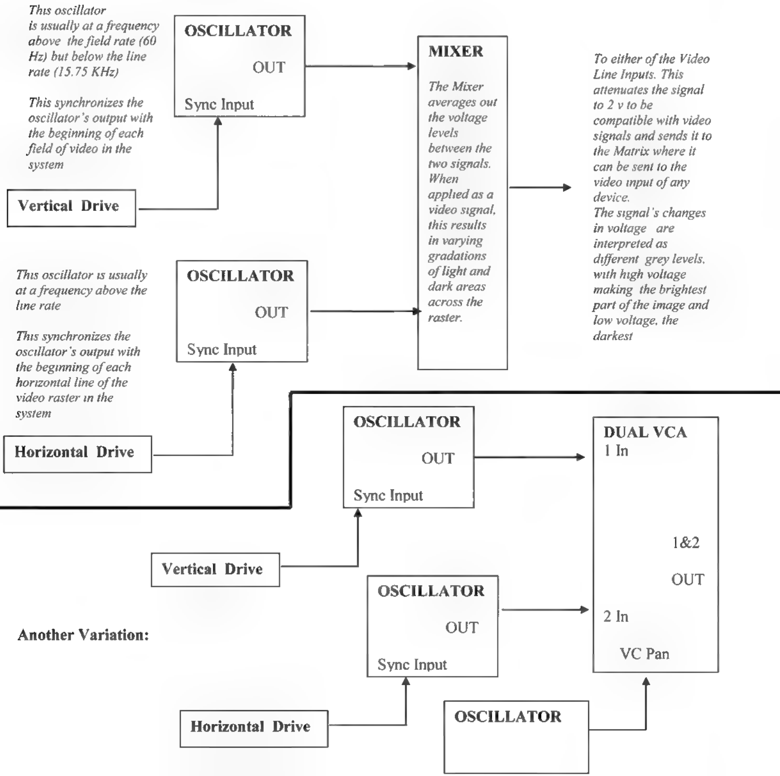


Another Variation:



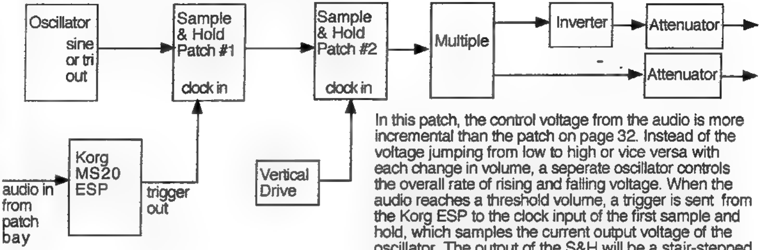
SAMPLE PATCHES FOR TURNING +/- 5 V SIGNALS INTO VIDEO SIGNALS

Oscillators, Mixers, Vertical and Horizontal Drive, and the Dual VCA are all modules in the +/ - 5 V System

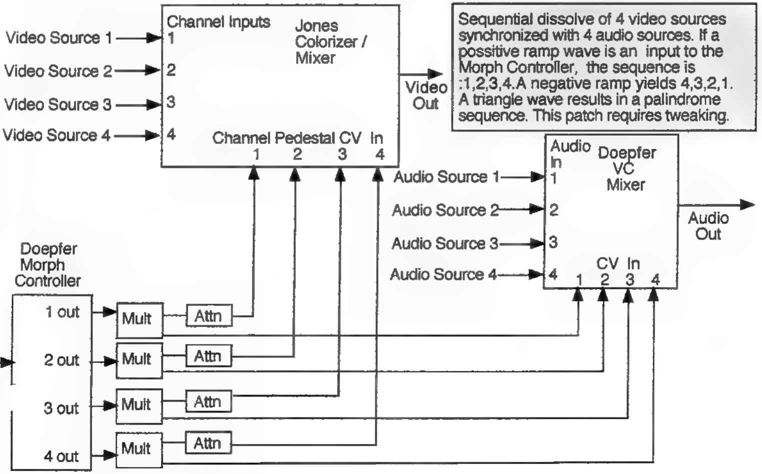


+ / - 5 V SAMPLE PATCHES: More Audio to CV / Colorizer & Morph Control

Audio to Control Voltage Alternate Patch

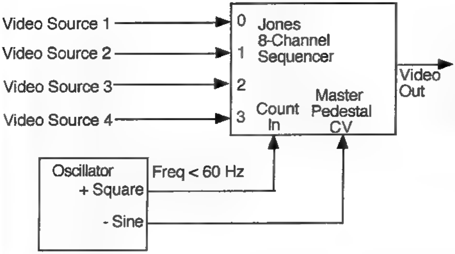


In this patch, the control voltage from the audio is more incremental than the patch on page 32. Instead of the voltage jumping from low to high or vice versa with each change in volume, a seperate oscillator controls the overall rate of rising and falling voltage. When the audio reaches a threshold volume, a trigger is sent from the Korg ESP to the clock input of the first sample and hold, which samples the current output voltage of the oscillator. The output of the S&H will be a stair-stepped pattern. The second S&H patch is for vertical interval switching. Finally the signal is split and inverted on one side to allow two outputs ,180 degrees out of phase ,for cross-fading or alternating two events.



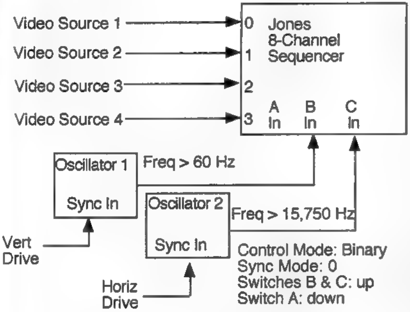
Sequential dissolve of 4 video sources synchronized with 4 audio sources. If a possitive ramp wave is an input to the Morph Controller, the sequence is :1,2,3,4.A negative ramp yields 4,3,2,1. A triangle wave results in a palindrome sequence. This patch requires tweaking.

+/ -5V SAMPLE PATCHES : JONES SEQUENCER



Patch #1:
The output will fade to black between each video source. The count, determinii the switch rate, and the master pedestal of the Sequencer's output are synchronized by the same oscillator, always causing the pedestal to go to low voltage during the switch point.

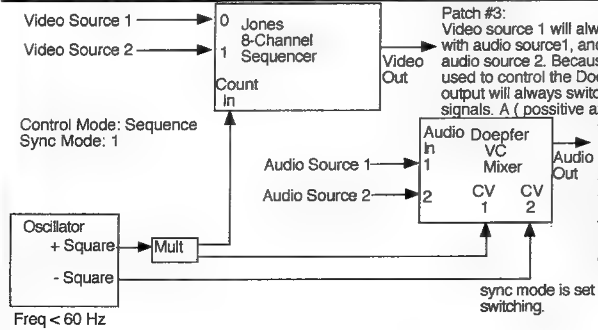
Control Mode: Sequence
Sync Mode: 1



Control Mode: Binary
Sync Mode: 0
Switches B & C: up
Switch A: down

Patch #2:
The Sequencer will display 4 video sources simultaneously in a multiscreen grid pattern (below). Oscillator 2, with its frequency set above the line rate and synced to the system's horizontal drive, will generate a vertical pattern. When sent to binary control input C, (and when inputs B and C are off) this will display Sequencer channels 0 and 1 within that vertical pattern. It is actually switching between 0 and 1 within each line of the raster .Oscillator 1, with its frequency just above the field rate, and synced to vertical drive, will generate a horizontal pattern. When sent to binary control input B, it will determine when (and therefore where on the raster) C will display channels 0 and 1, or 2 and 3.
The sync mode is set to 0, to allow control voltages above 60 cycles to pass through. For 8 video sources, a third signal could be added to input A.

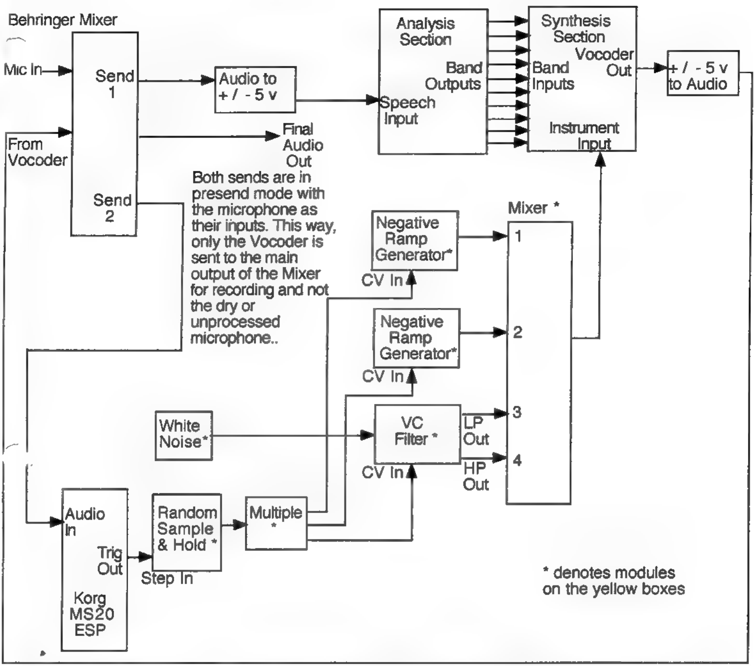
2	3	2
0	1	0
2	3	2



Control Mode: Sequence
Sync Mode: 1

Patch #3:
Video source 1 will always be synchronized with audio source1, and video source 2 with audio source 2. Because a square wave is used to control the Doepfer VC Mixer, the output will always switch between audio signals. A (possitive and negative) sine wave from the same oscillator will cross-fade the audio.If a second slower oscillator is applied to the VC input of the first for frequency modulation , it will accelerate and de-acceelearte the switch rate. The Sequencer's sync mode is set to 1 for vertical interval switching.

+/ -5V Sample Patch: Doepfer Vocoder System



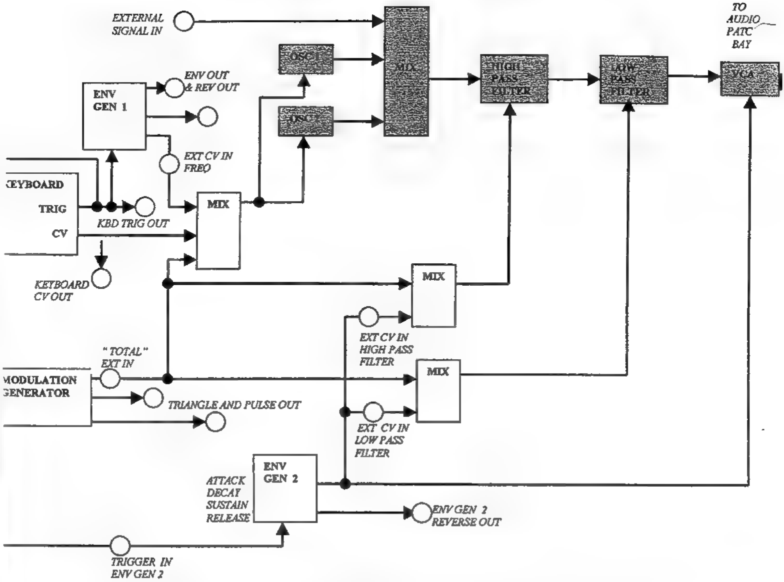
There are many variations to (and a seperate manual for) the Doepfer Vocoder System. This patch only uses the two main modules, the Analysis and Synthesis sections, with each of the band outputs going to their corresponding inputs (Low Pass to Low Pass, Band 1 to 1 etc). In this case, the Vocoder is treated as a black box, with two inputs (speech and instrument) and one output.

The microphone is sent to the speech input, first through the Behringer mixer, and then out of Send 1 to the audio +/-5v converter. This adjusts the signal to the best levels for the Vocoder Use the send's gain pots on the mixer to fine tune the incoming levels to the Vocoder. The best adjustment is when all of the led's in the Analysis section light up when speaking, and shut off when there is no sound.

The best results are when there are fairly complex waveforms sent to the instrument section. A single sine or triangle wave, for example, would not be effective.This patch uses three sources, two ramp wave generators, with frequencies set in the audio range, and filtered white noise. The relative levels of the three signals are adjusted through a seperate mixer.

The same microphone source is being sent to the Korg' MS20 ESP, which triggers a random S&H module. This is the main control for the three sources above, frequency modulating the two ramp waves, while changing the cut-off frequency of the VC Filter.In this way, every time there is a change in volume from the voice, there is a change in the parameters modulating the voice..

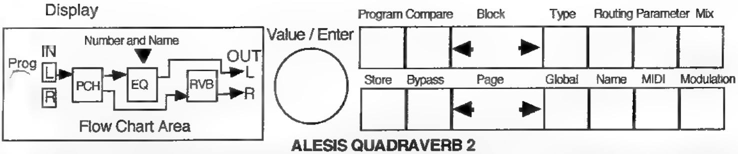
KORG MS-20 AUDIO SYNTHESIZER SIGNAL FLOW



Unlike the + / - 5 V system, the Korg Audio Synthesizer has a default patch :

Oscillators 1 and 2 are the primary sources for audio signals in the Korg. There are front panel controls for the waveshapes, octaves and tuning of each oscillator. The relative levels of the oscillator signals are controlled at the mixer where an external audio signal can be added from the audio patch bay or the + / - 5 V system. The High Pass Filter will allow only the high frequencies of the signal through. A cut-off knob determines the threshold frequency. There is also a Low Pass Filter for removing all but the lowest frequencies. Finally a VCA, or Voltage-Controllable Amplifier determines how loud the signal will sound and the Envelope Generator (# 2) controlling it determines how this loudness changes in respect to time, with separate controls for parameters Attack, Decay, Sustain and Release. Pressing any key on the keyboard will trigger Envelope Generator 2. The keys will also modulate the frequency of Oscillators 1 and 2. Envelope Generator 2 can also be used to control the cut-off points of the High and Low Pass Filters. The Modulation Generator is a low frequency oscillator that can be an additional control for the High Pass and Low Pass Filter cut-offs, and to frequency-modulate Oscillators 1 and 2.

The Korg allows for external control voltages to be applied at several points in this patch to either add to or bypass pre-existing control voltage sources in the Korg. For example, patching a pulse wave from the + / - 5 V system to the TRIGGER IN jack will replace the keyboard as the trigger source to Envelope Generator 2. Patching an oscillator from the + / - 5 V system to the TOTAL EXT IN jack will replace the Modulation Generator as a control for the Filters and Oscillators 1 and 2. The KEYBOARD CV OUT jack can be patched to a device in the + / - 5 V system to modulate its parameters with different notes on the keyboard. Several modules exist independently on the MS-20, including a SAMPLE AND HOLD, ENVELOPE GENERATOR 1, WHITE NOISE GENERATOR and the EXTERNAL SIGNAL PROCESSOR that can interface with both the Korg's main synthesizer and the + / - 5 V system.



ALESIS QUADRAVERB 2

THE Q2 has left and right inputs and outputs on the audio patch bays. You can patch a sound source directly this way, but usually the Behringer Mixer's sends, or auxiliary outputs, are sent to the inputs of the Q2. This way, any combination of audio signals being sent to the mixer can be routed to the Q2. The Q2's outputs are then sent to one of the mixer's main inputs, or its returns. There are several places to adjust levels for each (left and right) channel: the individual sends for each of the 16 mixer channels, the master send levels, the Q2's inputs levels and the Q2's output levels.

The *Value / Enter* control is both a rotary dial and a push-button, and is the main interface for the Q2.

When *Program* is selected, *Value / Enter* scrolls through the 100 factory presets and 100 user settings..

A **Program** is a stored patch represented by a flow chart in the display

A **Block** is the equivelant on an analog sound module.Up to 8 Blocks can be used in a program, memory permitting. (When the Q2 is out of memory, the display will read "DSP is full ").

There are four basic categories, or **Types** of blocks: **Pitch, Equalization, Delay and Reverb.**

Each of these types have several sub-types.

A Pitch block can be a Flanger, Phasor, Lezlie ,Pitch Shifter , Pitch Detuner ,or Ring Modulator

An Equalizer block can be a Low ,High or Band Pass Filter, Resonator, Tremolo, Phase Inverter, Graphic or Parametric Equalizer

A Delay block can be a Mono, Stereo or Ping-Pong Delay or a Sampler.

To change a block type:

In the display is a small black triangle above one of the blocks. Use the left or right arrow of the *Block* select to scroll to the block you want.

Select *Type*. The heading in the display wil show the block number and the type.

Use the *Value/ Enter* control to scroll through the 5 selections: Off, Equalization, Pitch, Delay and Reverb.

When you find the desired type, push *Value /Enter* to select it . The sub-type selected next. For example, If you selected Pitch the heading will now read " pitch type" , and you can scroll through the options (mono chorus, stereo chorus etc.), selecting one by pushing *Value/ Enter* .

Each selection has several parameters, depending on its type.

Select *Parameter*. The current parameter to be edited will have a numerical value that is underlined and to the right of the parameter name. Use the *Value/ Enter* dial to set a numerical value and push *Value/Enter* to select it . The next parameter will now be underlined and ready for editing.

The *Routing* select will allow you to scroll through various routing possibilities between the inputs, outputs and blocks, each shown in the display's patch diagram. The *Mix* select will allow the control of levels to each block.

In any of the Block modes (*Type, Routing, Parameter* and *Mix*), you can use the left and right *Block* arrows to move to the block that you want to edit.

Toggling *Compare* on and off allows you to hear the original patch before editing and compare it to what you currently have set.

When *Store* is selected, you can scroll to the user preset number that you want . Pushing *Value / Enter* will save the current settings to that location. It will not erase over factory presets.

MIDI is used to select a MIDI channel (leave on 1), MIDI thru (leave off) etc.

Modulation allows you to determine what MIDI parameter will control a specific Q2 parameter in real time and by how much.

Select *Modulation*.

With *Value/ Enter* , select a modulator (MOD 1-8)

Select the block that you want to control.

Select the specific parameter of that block to be controlled.

Select the modulation source (1-8).

Select the MIDI controller . This is the MIDI parameter(Pitch Bend , Aftertouch, Note Number, Continuous Controller etc. If it's Controller , select a numerical value).

Make sure that the ETC MIDI router has a device selected that is transmitting MIDI data to the Q2 (e.g. the JL Cooper Fadermaster, G4 w/ a MAX patch , or the keyboard), and that this device (or software) is set for the same MIDI channel number and parameter that you've selected for the Q2.

ensoniq PARAMETER REFERENCE Mirage

SAMPLING

The WAVESAMPLE parameters apply only to the currently selected wavesample. The SAMPLING CONFIG., GENERAL KEYBOARD and CONFIGURATION parameters can be saved using parameter 14.

SAMPLING CONFIG.

73	SAMPLE TIME ADJ. 30-99	76	SAMPLING THRESHOLD 00-63
74	INPUT FILTER FREQ. 00-99	77	USER MULTISAMPLING On-Off
75	LINE/MIC LEVEL INPUT On/Off		

COMMAND

11	SAVE LOWER KBD. SOUND SL	14	SAVE CONFIG. PARAMS SP
12	SAVE UPPER KBD. SOUND SU	15	COPY PROGRAM TO LOWER CL
13	SAVE BOTH KBD. SOUNDS SA	16	COPY PROGRAM TO UPPER CU

CONFIGURATION

81	MIDI OMNI MODE On-Off	86	EXT. CLOCK JACK SELECT On-Off
82	MIDI CHANNEL SELECT 01-16	87	INTERNAL CLOCK RATE 00-99
83	MIDI THRU MODE On-Off	88	SEQUENCER-LOOP SWITCH On-Off
84	MIDI CONTROLLER ENABLE On-Off	89	SEQ. FT. SW./SUS. PEDAL On / Off
85	EXT. SEQUENCER CLOCK On-Off		

WAVESAMPLE

26	WAVESAMPLE SELECT 01-08	63	LOOP END 00-FF	68	RELATIVE TUNING—FINE 00-FF
27	INITIAL WAVESAMPLE 01-08	64	LOOP END FINE ADJ. 00-FF	69	RELATIVE AMPLITUDE 00-63
60	WAVESAMPLE START 00-FF	65	LOOP SWITCH On-Off	70	RELATIVE FILTER FREQ. 00-99
61	WAVESAMPLE END 00-FF	66	WAVESAMPLE ROTATE 00-FF	71	MAXIMUM FILTER FREQ. 00-99
62	LOOP START 00-FF	67	RELATIVE TUNING—COARSE 00-07	72	TOP KEY 01-61

PROGRAM

The values of these program parameters (except GENERAL KEYBOARD) can be saved on diskette as any of four programs assignable to each sound.

KEYBOARD/PROGRAM

29	MONOPHONIC MODE On-Off	36	FILTER CUTOFF FREQUENCY 00-99
31	LFO FREQ. (SPEED) 00-99	37	FILTER RESONANCE (Q) 00-40
32	LFO DEPTH 00-99, 00=Mod. Wheel	38	FILTER KBD. TRACKING 00-04

GENERAL KEYBOARD

21	MASTER TUNE 00-99	24	KEYBOARD BALANCE 00-63
22	PITCH BEND RANGE 00-34	25	U/L PROGRAM LINK On-Off
23	KEYBOARD VEL. SENS. 00-63		

WAVESAMPLE

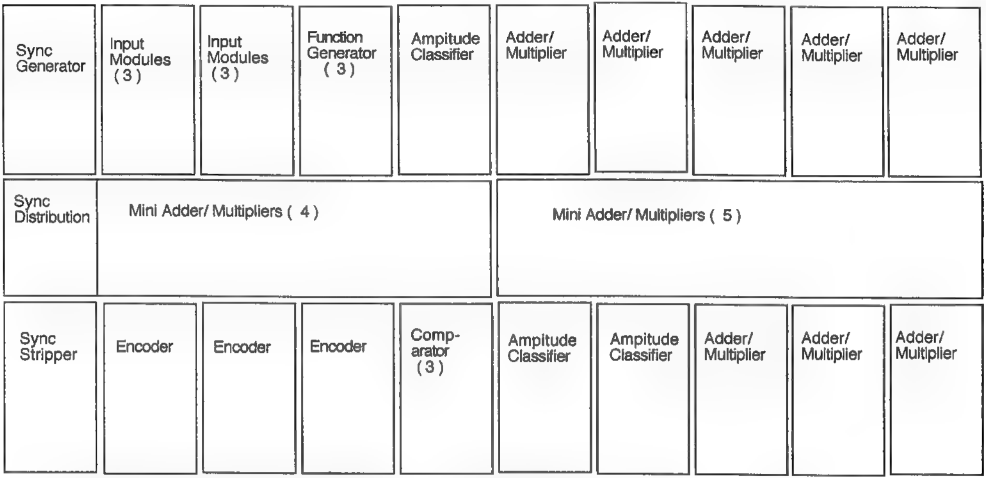
26	WAVESAMPLE SELECT 01-08
27	INITIAL WAVESAMPLE 01-08
28	MIX MODE On-Off
33	OSC. 2 DETUNE 00-99
34	OSC. MIX 00-63
35	OSC. MIX—VEL. SENS. 00-31, 00=Mod. Wheel

ENVELOPE

FILTER		AMPLITUDE	
40	ATTACK 00-31	50	ATTACK 00-31
41	PEAK 00-31	51	PEAK 00-31
42	DECAY 00-31	52	DECAY 00-31
43	SUSTAIN 00-31	53	SUSTAIN 00-31
44	RELEASE 00-31	54	RELEASE 00-31

ENVELOPE MODULATION

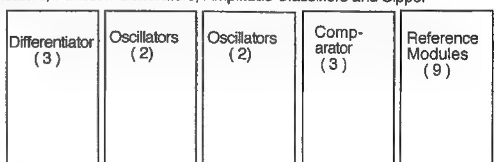
FILTER		AMPLITUDE	
45	ATTACK—VEL. SENS. 00-31	55	ATTACK—VEL. SENS. 00-31
46	PEAK—VEL. SENS. 00-31	56	PEAK—VEL. SENS. 00-31
47	DECAY—KBD. SCALED 00-31	57	DECAY—KBD. SCALED 00-31
48	SUSTAIN—VEL. SENS. 00-31	58	SUSTAIN—VEL. SENS. 00-31
49	RELEASE—VEL. SENS. 00-31	59	RELEASE—VEL. SENS. 00-31



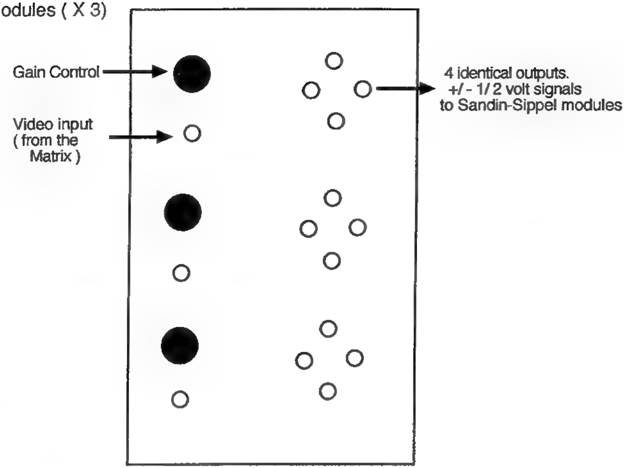
ETC Sandin-Sippel Image Processor

Main Sandin IP Layout

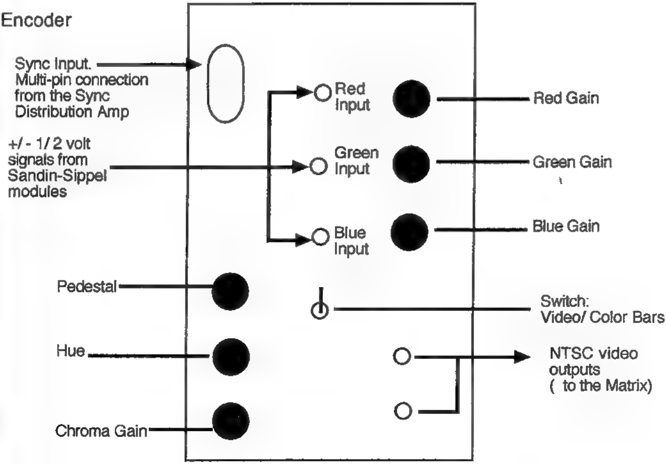
Not shown: Sippel Mix Master : (4) 9-Input Mixer Bank ;Sippel Key Stacker ; Sippel Envelope Follower and LFO Bank
There are six outputs from the ETC Matrix switcher to the Sandin (Matrix outputs 1 through 6)
These can be patched to any of the six Input Modules on the Sandin IP.
These modules strip sync and produce +/- 1/2 V signals at their output.
All of the other modules (Adder/Multipliers, Comparators, Differentiators, Function Generators, Amplitude Classifiers and Sippel devices) process signals in the +/- 1/2 V range. These are patchable in many configurations.
The final modules in the system that signals are sent to are the encoders.
Each of the encoders take +/- 1/2 V signals at their inputs and produce an NTSC video signal at their outputs .
The outputs can be sent to three inputs on the ETC Matrix (inputs BB,CC and DD)



Input Modules (X 3)



Encoder



Adder / Multiplier

The Adder Multiplier is used to add (superimpose), f[illegible] and gain control ([illegible]tiply) signals.

J I 1, J I 2, J I 3 and the inverted signal of J I 7 are added together to form input channel A.

J I 4, J I 5, J I 6 and the inverted signal of J I 8 are added together to form input channel B.

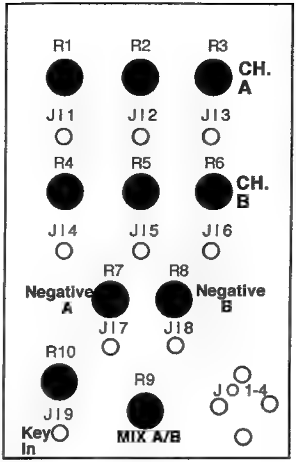
The knobs above the connectors (R1- R 8) control the gain (contrast) of each individual input.

The amount of channels A and B mixed into the output, J O 1 through J O 4, is depenedent on the position of R9 and the voltage inputted to J I 9.

the effect of the knob position and the voltage are additive; the knob to the left and / or a maximun negative voltage on J I 9 will cause channel B to be outputted only. Similiarly, the knob to the right and / or a maximum positive voltage will cause channel a to be outputted only.

The knob at approximately the center with no voltage applied to J I 9 will cause half of channel A and half of channel b to be added together and outputted-

Dan Sandin



Function Generator (X3)

The Function Generator generates an output which is an arbitray function (with up to two points of inflection) of the input at J I 1. This results in an effect that is similiar to but more complex and controllable than photographic solarization.

The functions is controlled by R1, R2 and R3.

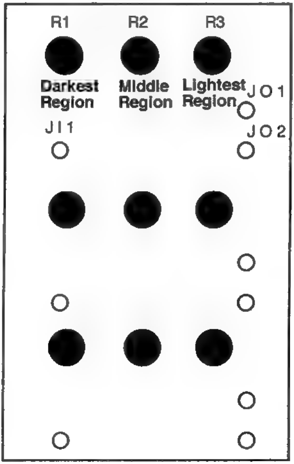
R1 controls the slope of the function for large negative inputs.

R2 controls the slope of the function for inputs near 0 voltages.

R3 controls the slope of the function for inputs of large positve voltage

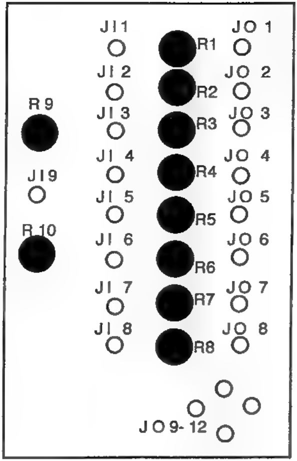
Clockwise is positive s[illegible]e. Counter-clockwise is negative slope.

- Dan Sandin



Amplitude Classifier

The amplitude Classifier takes an input signal at J I 9 and seperates it into eight contiguous regions varying from white to black.
The value put out by each region is controlled by R1 through R8 and by signals inputted to J I 1 through J I 8.
The output signals are available for each region seperately at J O 1 through J O 8.
The sum of these signals is available at J O 9 throgh J O 12. The effect of J I 1, J I 2, R1, R2 etc, is additive in each region.
R9 controls the gain of the signal inputted at J I 9, and R10 generates a bias (or constant gray level proportionate to the knob position) which is added to the input signal.



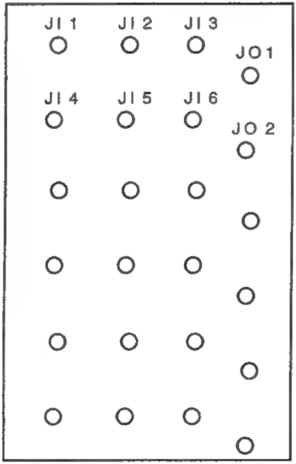
In general, R9 and R10 are used to match the incoming signal to the lightest (top) or darkest (bottom) portions of the 8 regions

- Dan Sandin

Differentiator (X 3)

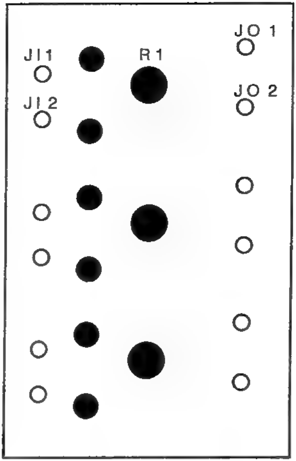
The differentiator produces an output which is proportionate to the rate of change of the input signal.
Fast rates of change correspond to edges in a picture and are preferrentially amplified by the module.
J I 6 amplifies only the sharpest edges
J I 5 amplifies the sharpest edges and slightly softer edges.
J I 4, J I 3, J I 2 amplify progressively softer and softer edges until by J I 1 almost all of the picture is amplified.

- Dan Sandin



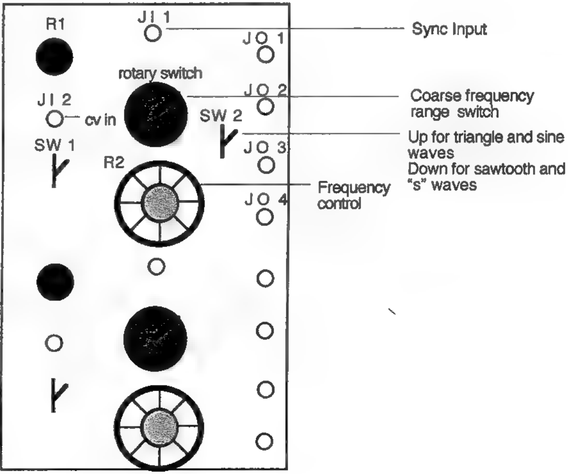
Comparator (X 3)

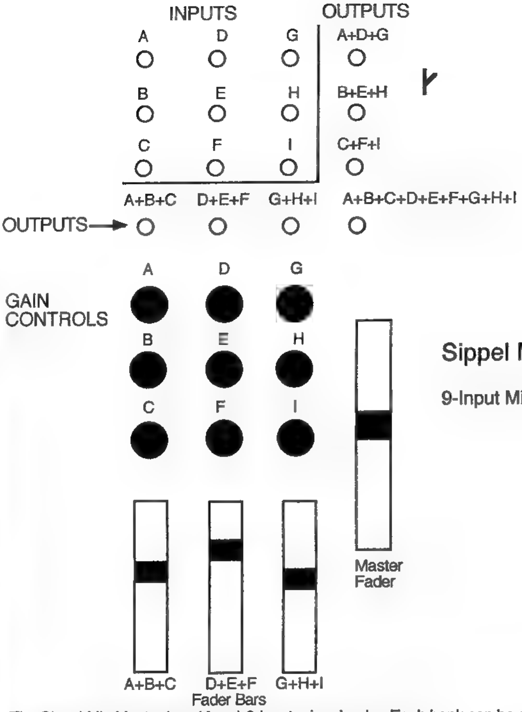
The comparator produces an output which is +.5 volts (white) if the input voltage a 1 is greater (more positive) than the voltage at J I 2.
The comparator produces an output which is -.5 (black) if the input voltage at J I 1 is less (more negative) than the voltage at J I 2.
With 0 volts or no input, the output will either be +.5 or -.5 volts into a 75 ohm load, depending on history.
The variable resistor (pot) R1, determines the positive feedback which controls the tendency of the module to stay in the state it is in. Typically it is turned fully clockwise
- Dan Sandin



Oscillator (X 2)

The oscillator generates a triangle wave output available at J O 1 and J O 2, and a sine wave output at J O 3 and J O 4 when SW2 is up.
When SW2 is down, the oscillator generates a sawtooth wave at J O 1 and J O 2, and a "s" wave at J O 3 and J O 4.
The rotary switch sets the coarse frequency range from 1/ 100 Hz to 1/ 2 Mhz.
R2 is a continuous frequency adjustment.
If SW1 is up, a signal inputted to J I 2 will control the frequency of the oscillator in combination with R2.
When SW1 is down, the voltage control is disabled but the oscillator is more stable.
A sync level (4 volt) signal into J I 1 will trigger the osc to stabilize patterns- D.S.





Sippel Mix Master

9-Input Mixer Bank (X 4)

The Sippel Mix Master has (four) 9-input mixer banks. Each bank can be divided into(three) 3-input mixers or grouped together into one 36-input mixer.

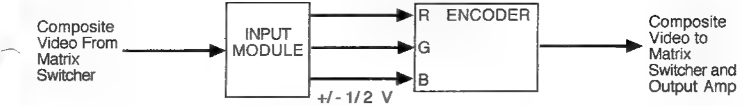
The mixer processes +/- 1/2 volt signals and is designed to be interconnected with the Sandin IP modules.

For each set of nine inputs there are seven different outputs. One is the sum of all nine inputs. The other six outputs are the sums of various combinations of inputs. The switch at the top right will group these inputs over to the next 9-input mixer bank to its right.

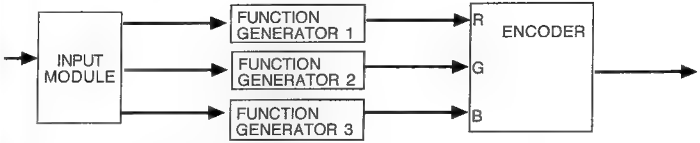
One application of these modules is as a final mix before outputting to the encoders. For example, the (A+B+C) output can be sent to the Red input of an encoder, the (D+E+F) output to the Green input and the (G+H+I) to the Blue. Each of the 9-Input Mixer banks can be sent to a seperate encoder with one left over for additional mixing..

SSIP SAMPLE PATCHES

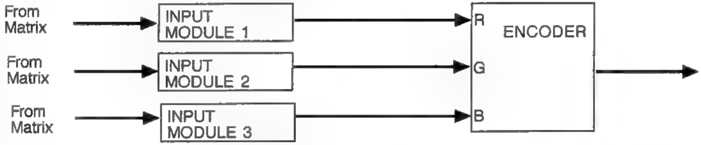
Testing the Signals



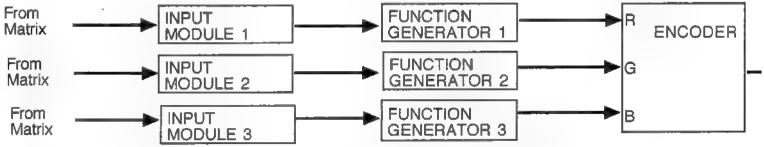
Simple Colorizer Patch #1



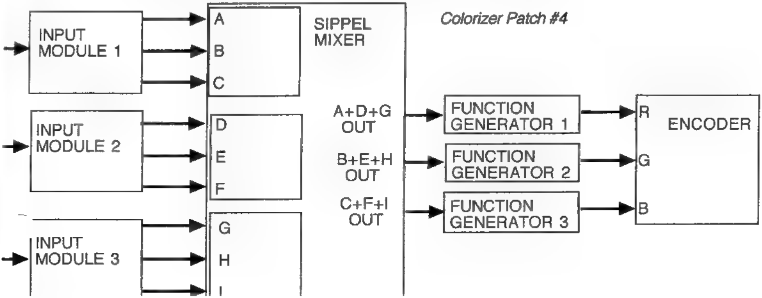
Simple Colorizer Patch #2



Colorizer Patch #3



Colorizer Patch #4



VIDEO - TECHNICAL GLOSSARY

CHROMA LEVEL: The color saturation of the video signal, usually measured with a vectorscope and adjustable with a proc amp.

CHROMA PHASE: A timing function that determines all of the hues in the chrominance signal, represented in degress (0 to 360) relative to color burst, usually measured with a vectorscope, and adjustable with a proc amp.

CHROMINANCE: Anything pertaining to the color characteristics of the video signal, such as chroma level and chroma phase

COLOR BURST (BURST): A signal placed at the beginning of each horizontal line and used as a reference for the chrominance information. On the waveform monitor, it is represented by a "blip" that extends +20 to -20 ire units and is located to the right of horizontal blanking and to the left of the luminance information. It is necessary for the proper recording of a video signal, even a monochromatic one.

COMPONENT VIDEO: A method of seperating the luminance and chrominance information in both the transmission and recording of the video signal in order to reduce noise and improve the quality of the image. This capability is specific to certain formats

COMPOSITE VIDEO: The combined luminance, chrominance, and sync information of a video signal

EXTERNAL SYNC: The capabalility of some video equipment (e.g. cameras, TBC's, switchers) to be "locked" to another device providing sync, such as a sync generator, in order to be used in a larger system. Sometimes this is done by providing a reference video signal, such as black burst, to the genlock input of the particular video device. At other times it is accomplished by giving specific sync signals from a sync generator (e.g. composite sync, subcarrier, blanking) to a video device as required.

FIELD: Half of a frame, made up of 262.5 horizontal lines of video information that are scanned in one sixtieth of a second.

FRAME: One complete scan (composed of two fields) from top to bottom of the 525 lines of video information. There are thirty frames in one second.

GAIN: Also called "video level", it is the amount of contrast in a video signal, measured with a waveform monitor in "ire" units, (with 100 ire units representing full gain) and adjustable with a proc amp.

GENLOCK: A circuit or feature on a particular video device that allows for it to be synchronized with other video devices.

HORIZONTAL BLANKING: The period of time on each horizontal line when there is no video information. On a monitor, this is the period when the electron beam is shut off so that it can return from the right side of the picture tube back to the left side in order to begin its next line of scanning. On a waveform monitor, it is represented by a drop to -40 ire units on the left side of the waveform.

H-PHASE: The horizontal timing adjustment of a video signal that results in shifting the raster from left to right

LUMINANCE: Anything pertaining to the monochromatic characteristics of the video signal, such as gain and pedestal

PEDESTAL: Also called "set-up", it is the brightness information of the video signal, determining its blackest level, usually set at 7.5 ire units on a waveform monitor , but adjustable with a proc amp.

PROC AMP(PROCESSING AMPLIFIER): a device or circuit that enables changing some parameters of the video signal (such as gain, pedestal, chroma phase, and chroma level).

SYNC (SYNCHRONIZATION) GENERATOR: A device that functions as a sort of "master clock" for all of the video devices incorporated into a video sytem. It outputs several types of synchronization pulses,as is required by individual video machines. The six sync signals are horizontal drive, vertical drive, composite sync, blanking, burst flag, and subcarrier. In addition,sync generators often have "black burst" outputs to besupplied to the genlock input of a device to give it external sync.

TIME BASE CORRECTOR (TBC): is a device which compensates for timing errors on a video tape recorder. It has at least three applications:

1. It corrects some ,but not all of the problems inherent in generational loss when dubbing or editing from one videotape recorder to another.
2. It usually has a proc amp built into it to allow for adjustments of luminance and chrominance information
3. It is necessary for using a videotape recorder (or any video device that, otherwise, is not externally syncable) in a larger video system for the purpose of combining prerecorded tape(s) with other video sources. Each videotape source requires its own TBC.

ECTORSCOPE: A display device that measures the chrominance information of a video signal, represented by a color wheel with chroma level along the radius of the circle, and chroma phase

along its circumference. There are specific marks for video's primary (red, green, and blue) and secondary (magenta, cyan, and yellow) colors on the display.

VERTICAL BLANKING: The period of time during each field of video when there is no picture information. On a monitor, this is the period when the electron beam shuts off so that it can return from the bottom of the picture to the top in order to begin scanning another field.

VERTICAL INTERVAL SWITCHING: Any switch or change from one video source to another where the actual time of the change takes place during the vertical blanking interval. This is done to avoid any visible artifact or "glitch" during the switch point

WAVEFORM: A graphic representation of an electronic signal (e.g. video or audio) with time represented in the horizontal axis and voltage in the vertical. Voltage, in video, corresponds to luminance, and in audio, to amplitude.

WAVEFORM MONITOR: A display device for measuring the luminance and sync information of a video signal. The display usually shows one horizontal line of video, which takes place in 1/15,750th of a second (30 frames times 525 lines). The combined sync and video signal is one volt. The video waveform is measured in ire units. The blanking level (seperating sync from picture)is at zero ire units. The picture information is ideally the largest range between 7.5 (pedestal level) and 100 ire units.

NEGATIVE RAMP WAVE GENERATOR

POSSITIVE RAMP WAVE GENERATORS & INVERTERS X 2

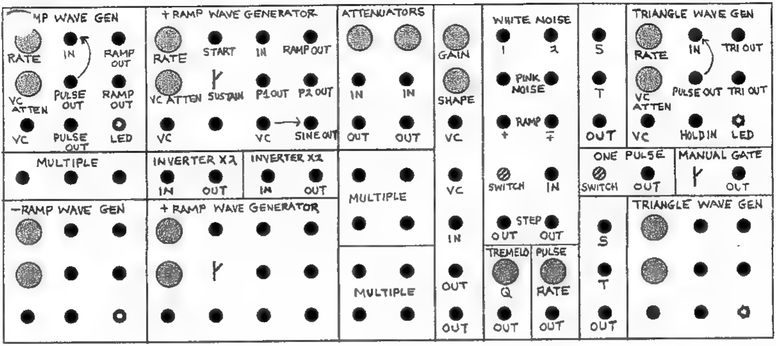
ATTENUATORS & MULTIPLES

RANDOM SIGNAL GENERATORS

WAVESHAPER

SAMPLE & HOLDS

TRIANGLE WAVE GENERATORS



VOLTAGE-CONTROLLABLE OSCILLATORS

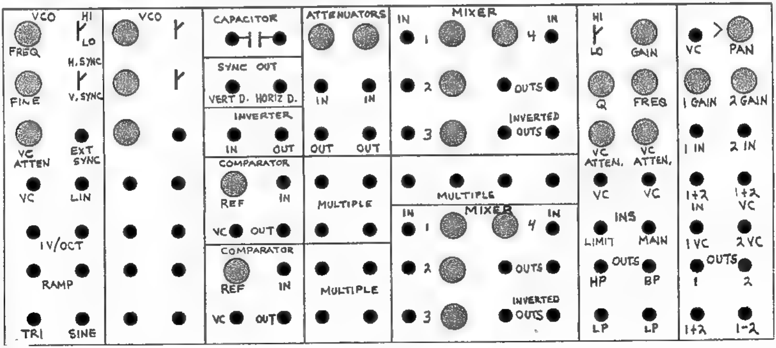
CAPACITOR, VERT ICAL & HOR IZ. DRIVE, INVERTER, COMPARATORS

ATTENUATORS & MULTIPLES

MIXERS & MULTIPLES

VOLTAGE-CONTROLLABLE FILTER

DUAL VOLTAGE-CONTROLLABLE AMPLIFIER



+/- 5 VOLT ANALOG SYSTEM MODULES

The Center's Analog Synthesizer is a modular system for creating different types of changing voltages. The final outputs of the Synthesizer will be used in two distinct ways:

1) as control signals for the image processing modules
2) as synthesized audio for sound tracks

The system has been designed specifically to produce slowly changing voltages suited to controlling various parameters on the imaging modules such as fading, keying, colorization and so on. One way to view the Analog synthesizer is as a machine that combines various simple changes (represented by changing voltages, which are usually periodic in nature) for the purpose of obtaining interesting and complex changes in imagery. Our model has been the modular electronic music synthesizer, and we have retained many specific standards from that industry. The Analog Synthesizer is compatible with most commercially made audio synthesis equipment, so you are encouraged to bring your own synthesizers to the studio if you wish. If you plan to do so, please check first with the Center's staff to be sure that the appropriate cables are available.

To use this machine you will have to think about voltage control. We can think of voltage as a quantity that can be measured discretely, for example a given number of volts, 5V. For this to be meaningful we need a point of reference. Usually ground (earth) potential is used as a reference as 0V. All sources of constant voltage (DC which stands for direct current) are signed. They have a positive and negative terminal, like a battery. If the negative terminal were connected to ground, then our 5V source will have +5V with respect to ground at its positive terminal. If the positive terminal were connected to ground instead, then we would have -5V at the negative terminal with respect to ground. In the Analog Synthesizer we use both polarities of voltage with respect to ground, and the term "bias" to describe this relationship.

Our control voltage standard is -5V to +5V. Both the Analog Synthesizer and the video image processing modules have been built to respond to this voltage range. This means that a certain aspect of a module's output will be varied from one useful extreme to the other by a sweep of -5V to +5V. This range can be expressed as 10V peak to peak, abbreviated as 10V P-p. For example: in controlling video pedestal, -5V at the control input would produce black while +5V would yield a white pedestal level, with values in between producing various grey levels. You will find that the useful range will lie somewhat within the -5V to +5V standard. So it will take less than 10V P-p (peak to peak) to sweep the effective range. Since the Analog Synthesizer puts out 10V P-p, it is a simple matter to reduce this voltage to the desired level.

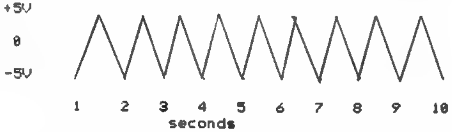
Most of the control knobs on the video modules have

associated jacks for taking in control voltages. A changing control voltage applied to one of these jacks has the effect of "automatically" turning the knob. Advantages of using a control voltage instead of just turning the knob include (1) variations which are smoother or quicker than would be possible by hand, (2) increased precision and (3) step-like movement. Manual control is useful for complex changes.

There are three important aspects of a control voltage:

1. GAIN the total voltage excursion, expressed in volts peak to peak
2. BIAS the relative placement of the waveform relative to ground
3. WAVESHAPE the nature of change with respect to time

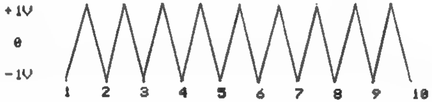
We represent these aspects graphically in the example below by plotting voltage (expressed along the Y axis) with respect to time (expressed along the X axis).



In this example, the GAIN is 10V P-p, the BIAS is centered at ground or 0V, and the WAVESHAPE is called triangle. The rate or FREQUENCY of this signal is 1 Hertz, expressed as 1 Hz. This means that the waveshape takes one second of time to complete its form and begin to repeat itself. A triangle waveform is called PERIODIC because it repeats itself on a regular basis within a given period of time. Hertz (Hz) refers to the number of cycles the waveform goes through in one second.

To illustrate how such a control signal can be used in the video synthesizer, let's take this example signal and look at how the patch would be set up.

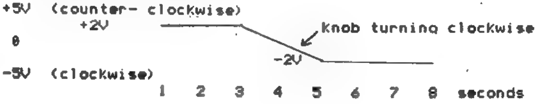
Signal at Point B:



The attenuator, which means reducer, is simply a potentiometer (pot) or knob that enables us to lower the gain of a signal with respect to ground. An ordinary volume control is an application of this type of device. In the patch, Point A is the example signal from the Analog Synthesizer. This is patched to the input of the attenuator. Depending on the knob setting, we can obtain any peak to peak value less than 10V P-p at the output of the attenuator. The graph "Signal at Point B" shows the attenuator output, arbitrarily selected to be 2V P-p. This is the signal we will apply to a control input on a video module. Here we must examine how the control knob on the video module interacts with the incoming control signal.

The first point to understand is that the knob is also a source of a control voltage. If there is no input to the VC input jack, then the knob voltage is the only one used. When a voltage is applied to the VC input, it is mixed with the knob voltage. Since it is the nature of our mixers to invert (change the sign) of the incoming voltage, the knobs have been made so that counter-clockwise represents +5V and clockwise represents -5V. This is so that after the mixer, the voltage will be positive for clockwise-of-center rotations. Thus turning the knob clockwise results in black to white, low to high and so on. This also means that, with the knob centered at 0V, a control input of +5V is the same as having the knob all the way counter-clockwise with no control input. You must think of a falling (negative going) control signal as producing the effect of turning the knob clockwise.

Belowis a graph of the voltage output from a knob. The following graph represents an inverted mix of this knob voltage and our attenuated control signal. You can see how the relative placement of the control signal is moved by the knob. This is called BIASING the signal.



Let's continue to analyze how the attenuator and bias knobs allow us to get the effect we want. As an example, let's control the clip of a keyer. With no control voltage input, the extremes that we wish are at these knob settings: and which are about one-third of the total knob rotation. From this we can

guess that we will need about 3 or 4 volts P-pk to get the entire sweep we require. As long as we start with a larger signal, the attenuator will allow us to achieve the proper gain. With the signal applied to the VC input, the control knob can now be used to bias the signal so that the start point and end point of the effect are where we want them. At this point it is a matter of adjusting the knobs while observing the image in order to set up the desired effect.

Now we will look at the different types of signals in the Analog Synthesizer. A signal can most generally be defined as a voltage that changes with respect to time. In the Analog Synthesizer we can think of a "signal" as the changing voltage of an oscillator that we are going to process and use as an input to video image processing modules. The terms signal and control signal are relative and refer only to use. In general, a control is lower in frequency than the signal it is modifying.

In the Analog Synthesizer signals are classified according to bias, function and waveshape.

BIAS

1) +- Signal This type of signal usually remains within +-5V. However if several of these are added in a mixer, the total possible range is about +-12V. This is the maximum voltage excursion in the Analog Synthesizer.

2) + Signal This type never goes negative and usually stays in the 0 to +5V range. Certain modules output this type of signal, and if a negative signal is presented at their inputs it will not pass through. The output will hold at 0V.

FUNCTION

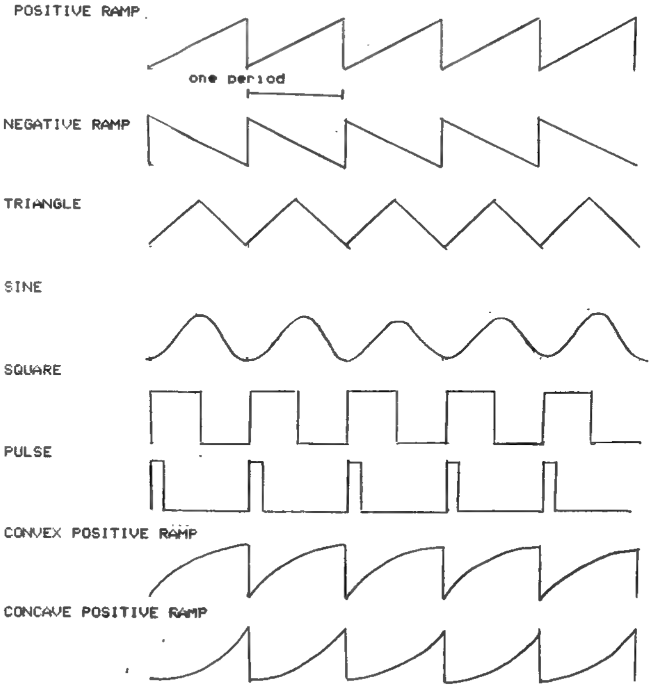
1) PULSE This is sometimes called TRIGGER. It is a short positive voltage excursion from 0 to +10V and back. It is the point in time that the voltage jumps high that is significant. This point may be used to determine the start of other events in the system.

2) GATE A signal which is either 0V or +5V. 0V signifies OFF while +5V signifies ON. This acts like a switch to control the duration of an event, or how long it goes on.

WAVESHAPE

Signals classified according to waveshape are named for their graphic representations. See the following page. These periodic waveforms repeat. The number of periods in one second is the frequency in Hertz. The terms positive and negative ramp refer to direction of change, not to bias. Note that inverting (turning upside-down) a ramp or pulse changes the shape, while inverting a triangle, sine or square does not.

These are commonly used waveforms. The YX axis represents voltage. The XY axis represents time.



DETAILED MODULE DESCRIPTION

The Analog Synthesizer has two boxes each with its own set of modules. The panel controls are listed first and then the functions are described.Module panels have the following features: 1) Signal inputs 2) control inputs 3) one or more outputs 4) knobs for setting initial points (bias knobs) 5) knobs for inverting or attenuating control voltages and 6) special devices such as switches or lights. Inputs are generally to the left and top while outputs are to the right and bottom. Black lines between jacks indicate internal electrical connections.

NEGATIVE RAMP

RATE	Bias pot setting initial rate of fall
VC	Attenuator/inverter pot with control voltage input
IN	Main signal input
OUT	Main signal output
P	Pulse Output
LAMP	Output level indicator

The function of this module is to limit the rate at which the output can follow as the input voltage falls. This rate is initially set by the RATE bias control, with more clockwise settings corresponding to higher rates. The rate may also be varied by a control voltage applied at VC. The knob above VC attenuates and/or inverts the control voltage in this manner. At the center of its rotation, an incoming control voltage will be most greatly attenuated, that is will have the least effect. Turning the knob to the right, clockwise, will cause a positive voltage being presented at the VC input to effect a higher rate. Counter-clockwise rotation with a positive VC input will lower the rate. The farther the knob is turned in either direction, the greater the effect. Negative voltages may be applied to the VC input.

The negative ramp module puts out only positive voltages, thus the input must be positive to pass through. There are two outputs. The main signal output will accurately follow a rising voltage at the input, while limiting the rate of a falling input. The pulse output remains at +10V while the main output is close to 0V. If the main output rises above about .2V, the pulse output will go 0V. The lamp indicates main output voltage, getting brighter as the main output increases in voltage. If the output frequency is rapid, the light will appear to remain constant at a medium brightness.

What happens if the pulse output is patched to the main signal input? First, the output has been at 0, so the pulse output is high, +10V. When the connection is made the main output rises quickly following the rising input voltage, but as soon as

the main output rises this causes the pulse output to go to 0V. Since the main output can't fall any faster than the control will allow, we will get a falling ramp at the main output. When the ramp approaches 0V, the pulse output jumps high and the process is repeated. Thus we have an oscillator with ramp and pulse outputs.

When patched as above, the two negative ramp modules on the Analog Synthesizer each have different frequency ranges. These are shown below.

MODULE	RANGE	with CONTROL VOLTAGE
Top Negative Ramp	30 sec/cycle to 500 Hz	up to 1200 Hz
Bottom Neg. Ramp	17 sec/cycle to 1000 Hz	up to 2500 Hz
Top Positive Ramp	23 sec/cycle to 1000 Hz	up to 1700 Hz
Bottom Pos. Ramp	7 sec/cycle to 2000 Hz	up to 4000 Hz
Top Triangle	120 sec/cycle to 1700 Hz	
Bottom Triangle	90 sec/cycle to 2000 Hz	

POSITIVE RAMP

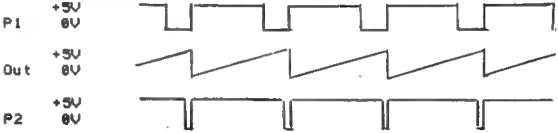
RATE	Bias pot setting initial rate of rise
VC	Attenuator/invertor pot with control voltage input
IN	Main signal input
OUT	Main signal output (TOP)
P1	Pulse output one
P2	Pulse output two
START	Input for starting ramp
SUS	Input for starting ramp and sustaining at +5V
Switch	Performs gate function for sustain
VC	Voltage control of waveshape from lower output
OUT	Sine type waveform output (BOTTOM)

The function of this module is to limit the rate at which the output can folllow as the input voltage rises. This rate is controlled in a manner similar to the negative ramp. There are four outputs. The main signal output limits the rate of a rising input, while accurately following a falling input. P1 is low while the ramp is above 4.5V and goes high at the point the ramp wave falls. There must be an input to Start or Sus to get an output from P2. P2 stays high while the ramp is rising and holds at 0V if the main output is also at 0V. For both pulse outputs high equals +5V. Like the negative ramp, an oscillator can be patched by connecting P1 to IN. The resulting ramp wave at the main output is about 4V P-p from +.5V to +4.5V. A sine-type waveform is simultaneously available at the lower output, and its shape is voltage controllable. This output is also positively biased and has a gain of about 2V P-p.

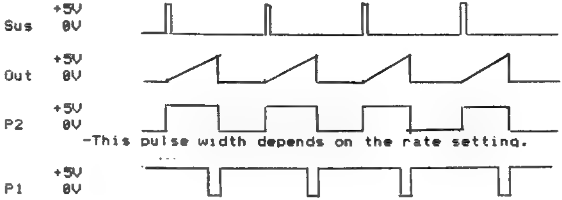
An oscillator can also be created by patching P1 to Start or Sus. This will give an output at P2 as well as raising the main signal output gain to 5V P-p.

A rising ramp may be started by supplying a trigger pulse to the Start input. When this ramp is completed and returns to 0V, it will remain at 0V until another trigger is received. A trigger applied to Sustain will also start a ramp. If a gate is applied to Sustain, a ramp will be initiated also, and if the gate is still present when the ramp has reached its maximum, the main output will hold at +5.5V until the gate is removed. A gate patched to Start will perform the starting function, but will not sustain the output.

P1 Patched to Sustain



External Pulse Patched to Sustain



WAVESHAPER (WS)

GAIN	Input attenuator
SHAPE	Bias pot setting initial waveshape
VC	Control voltage input #1
VC	Control voltage input #2
IN	Main signal input
OUT	Main signal output

The purpose of this module is normally to convert a positive ramp wave into a sine-type wave with a voltgae controllable waveshape. For proper operation in this mode the input should be a positively biased positive ramp wave (such as the output of a positive ramp) with a gain of about 2V P-p. An input attenuator is provided for setting this gain.

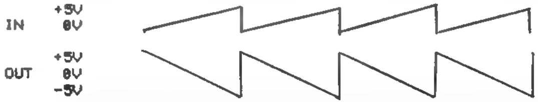
The shape control is a bias pot which sets the initial waveshape. Centered, the output is an approximate sine wave. Varying the control results in a more ramp-like waveform at the output. The extremes of rotation produce nearly concave positive or negative ramps. The output is positively biased with a gain of about 5V P-p.

The VC input directly below the shape control allows voltage control similar to the shape control pot. With the pot centered, +-5V is sufficient to sweep the pot range. The lower VC input has the effect of biasing the output so as to cut off the lower portion of the signal, which also changes the waveshape.

Other waveforms may be applied to the input. Note that at audio frequencies the WS is used as a timbre modifier.

INVERTER X2

This module ,which has no controls, is designed to convert a 0 to +5V signal to a +-5V signal. Since it also inverts, the in/out relationship looks like this:



You can see that an input of 0V (no input) will leave the output at +5V. +2.5V in comes out 0V. +5V in comes out -5V. The gain is doubled. A hint: If you want to invert but leave the output still at 0V to +5V, simply attenuate the input to 2.5V. Note that a negatively biased input will cause the output to go above +5V. This module is meant to increase the gain available from the Ramp modules. Since the output from the Triangle patched to oscillate is -1V to +4V, passing this signal through Invert X2 will give +7V to -3V out. This is still within a usable range.

RANDOM

WHITE 1	White noise output with energy concentration in center
WHITE 2	White noise output with energy concentration at edges
PINK	Pink noise output filtered from WHITE 1
RAMP +	Fast random ramp output, positive bias, 5V P-p
RAMP +-	Fast random output, +-bias, 10 V P-p
SAMPLE	Button changes Step outputs to new random level
SAMPLE	Jack accepts trigger pulse input for above function
STEP +	Random held voltage output, + bias
STEP +-	Random held voltage output, +- bias
TREM	7 Hz sinewave output with randon amplitude

Q	Varied randomness is TREM output
PULSE	Random pulse output
RATE	Varies range of random pulse frequency

The random module is a source of different kinds of randomly changing voltages. Random sources are categorized by their average rates of change. White noise contains the widest range of frequency variations: the entire audio range, 20 Hz to 20 KHz. Pink noise contains less high frequencies than white noise, while the random ramps are low in frequency. Patching these sources to an audio monitor will give you a good idea of this. The step outputs have a rate of change equal to the sample pulse rate.

White 1 output is biased about ground and is generally 5V P-p. The probability for an instantaneous output is higher for values nearer to ground. White 2 is 8V P-p biased at ground, with greater probability of an instantaneous output being at either + or -4V.

The Step outputs are from a sample- and- hold- connected internally to a random source. Pushing the button or supplying a pulse to Sample (the only input on the module) will set the Step outputs to new random levels. These voltages drift slightly.

Patching the random tremelo output to an oscillator VC input will quickly show how this functions. Notice a time lag after turning the Q knob before the effect changes.

The Rate control adjusts the random pulse output from a pulse every few seconds to dozens per second. When setting this control allows 15 seconds or so to observe the effect at one setting.

ONE SHOT

S	Sample Input
T	Track input
OUT	One shot output

This module has no controls. Normally the output sits at +10V. If a trigger pulse is supplied to the S input, the output will fall to 0V for a preset time interval of about 1 ms, then rise quickly back to +10V. A gate to the T input will cause the output to hold at 0V as long as the gate is present.

Patching the output of this module to the Hold input of the Triangle module creates a sample and hold. During this patch, a gate to the Track input returns the Triangle to its following mode.

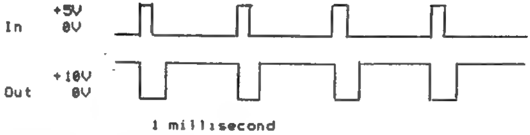
ONE PULSE

This module puts out one 100 uS pulse each time the button is pushed. Use this for a manual trigger.

GATE

This switch when up applies +6V to its output jack and 0V (ground) when down. Use this for a manual gate (patch to Hold, Track, Sustain, etc.).

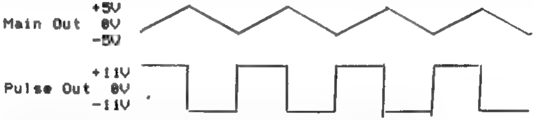
In/Out Waveforms for One Shot



TRIANGLE

RATE	Bias pot setting initial triangle period
VC	Attenuator pot with control voltage input
IN	Main Signal input
OUT	Main signal output
P	Pulse output (+-11V, 22V P-p)
H	Hold input
Lamp	Output level indicator

The triangle module limits the rate at which the output can follow both rising and falling voltages at the input. Unlike the Ramp modules, the Triangle inputs and outputs may be biased positive or negative. The main and pulse outputs are related in this manner: as the main output falls below -1V, the pulse output goes to +11V and holds there until the main output rises above +4V. The pulse output then falls and holds at -11V until such time as the main output again falls under -1V. Patching the pulse output to IN yields an oscillator with the following waveforms:



Another difference from the Ramp modules is that the VC attenuator pot does not invert an incoming control voltage: positive voltages always increase the rate.

The Hold input accepts a +5V or higher gate signal. When the gate is presented the main output will hold at the voltage it had at the moment the gate went high. This same function amy also be accomplished by bringing the VC input to a sufficiently negative value, depending on the initial rate setting.

The lamp is an output level indicator which functions similarly to the lamp on the negative ramp module.

ANALOG SYSTEM: MODULES IN BOX 2

VOLTAGE CONTROLLED OSCILLATOR (VCO)

FREQ	Bias pot setting initial frequency, wide range
FINE	Bias pot setting initial fequency, narrow range
VC	Most sensitive control input, with attenuator
LIN	Least sensitive control input, inverted
1V/OCT	Control input set for 1 V increase to double frequency
HI/LO	Audio/subaudio range selector
H/EXT/V	Sync selector switch
EXT	Sync input
RAMP	Sawtooth waveform output
TRI	Triangle waveform output
SIN	Sine waveform output

This module is a music quality oscillator. Its function is to generate periodioc waveforms of three shapes, the controlled parameter being the frequency of the outputs. There are a number of control inputs which may be used simultaneously. The outputs are all the same frequency and are all similarly affected by the controls. A HI/LO switch determines the mode of operation. HI mode is that of an audio range oscillator. LO mode is that of a very low frequency control oscillator.

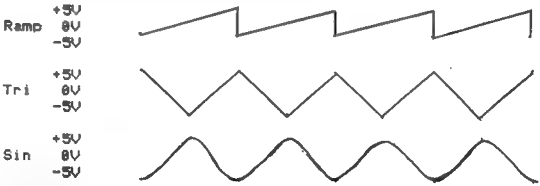
In LO range the freqequency is manually variable by the bias pots from 1 cycle every 20 seconds to about 15 Hz. In HI the manual range is 16 Hz to 16 KHz. Both of these ranges can be expanded with voltage control. Negative control voltage will lower the LO range infinitely until oscillation stops. Positive control voltage can extend the HI range up to 100 KHz, however at this frequency the outputs are degraded in amplitude and shape.

All FM (Frequency Modulation) inputs allow exponential control of the frequency. This means that for an increase of a set amount of voltage (for example, 1V) the frequency will be multiplied by some factor. In the case of the V per octave inputs, a 1V increase will double the frequency. The VC input with attenuator allows adjustment of this factor, and at high settings the frequency may be multiplied by a factor of 4 or more for each volt increase of control voltage. The LIN control input is much less sensitive, and operates inversely: an increase of control volgage lowers the frequency. This ratio is set at approximately 6V/octave.

Sync options are selected with the sync switch. Center is

off, while H/EXT normally supplies horizontal sync for use at high frequencies (above 15 KHz). Should a signal be patched to the EXT sync input, this input is selected instead of horizontal sync. Signals patched to EXT should have a sharply rising edge for proper syncing.The V position selects vertical sync. Standard video sync must be plugged to the BNC inputs at the left of the panel for these functions to be used.

All outputs are standard +-5V signals. The phase (relative changes) of the outputs are shown below.



COMPARATORS

Under the heading of Comparators are three small modules above the Comparator modules. These will be described first.

1) Capacitor A patchable capacitor is available between the two jacks containing the symbol for capacitance (-||-). Either jack may be the input. Its function is to block the offset bias of an audio frequency signal, so that the output is rebiased around ground.

2) V and H Vertical and horizontal sync pulses are available at these jacks, pulses going from zero to +8V for system compatibility. Example: Start a ramp with a V pulse.

3) Invert A standard analog inverter is made available for changing the sign of the input voltage.

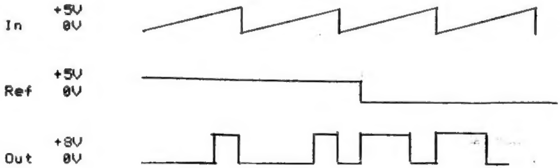
Comparator Panel

IN	Comparator input
OUT	Comparator output
VC	Control voltage input for reference
REF	Bias pot for setting initial reference point.

The function of the comparator is to compare two voltages and signal when one is higher than the other. The output is high (+8V) if the input is higher than the reference voltage, and zero volts if the input voltage is lower than the reference. Thus if a periodic voltage is applied to the input and regularly crosses the reference point, a pulse wave is the resulting output.

Since the duty cycle of the pulse wave is determined by the relative setting of the reference, this parameter is variable and may be voltage controlled. This is called pulse width modulation. The comparator may be used to obtain pulse or square waves from any oscillating module. Notice that a square wave is a special case of a pulse wave for which the duty cycle is 50%. At audio frequencies pulse width modulation produced interesting timbral changes in the sound. One useful sub-audio application would be to control a VCA. The VCA would switch rapidly from zero to full gain. An attenuator on the VCA VC input would be helpful.

Below are the comparator input, reference and output as an example to demonstrate the function:



MIXERS

1,2,3	Inputs with associated attenuators
4	"Wild" inputs
- +	Bias pots for setting output offset voltage
OUT	Main output, non-inverting
INVERT	Main output, inverting

The mixers enable a combination of the outputs of two or more modules, with manual control of the mix. All four inputs are added together. This means that if you put the same signal into two of the inputs turned up full, the output will be twice the input. The Wild input simply has no attenuator. This allows the mixers to be patched together for a six-input mixer. Any signals in the Analog Synthesizer may be mixed, but note that up to +-11V may result. The bias pot allows offsetting which is useful when mixing control volages.

VOLTAGE CONTROLLED AMPLIFIERS (DUAL VCA)

VC >	Control input for panning and fading
PAN	Bias pot setting initial pan/fade
1,2 GAIN	Bias pots setting individual initial gains
1,2 IN	Respective inputs for VCA 1 and VCA 2
1+2 IN	Input simultaneously to VCA 1 and VCA 2
1,2 VC	Respective gain control inputs for VCA 1 and VCA 2
1+2 VC	Simultaneous gain control input for both VCAs
1,2 OUT	Respective VCA outputs

1+2	Sum of the outputs of both VCAs
1-2	Sum of VCA 1 output plus the inversion of VCA 2 output

The VCA porvides a means of controlling the gain of a signal by a control voltage. Any signal, including subaudio, may be processed. This module consists of two independent VCAs with provisions for tandem use in various ways.

Each VCA has: 1) an input for the signal to be gain controlled 2) a control input 3) an output. A bias pot sets the initial gain point, then the gain is increased by positive control voltages and decreased by negative control voltages. With the bias pot set for zero gain, a +5V control signal will give unity gain, that is, the output will be indentical to the input. Control voltages up to +10V will produce gains of up to two times the input.

Remember that the bias pot adds to the incoming control voltage so that s signal can be doubled by the pot being all the way in combination with a +5V control input. For instance, if a +-5V control were used in this case, the output would be varying from zero to two times the input signal amplitude.

The two VCAs are linked in the following ways. First, there is a third control input at the top of the panel for VC panning and fading. This input affects the two VCAs in opposite fashion: as the control voltage increases, VCA 1 gain increases, while VCA 2 gain decreases. As the bias pot is turned clockwise, the same is true. There is also a fourth control input labeled 1+2 VC. This control input affects both VCAs simultaneously in the same fashion as the individual VC inputs. All inputs may be used at the same time on this module.

There is also a 1+2 input which sends the signal to be modified to both VCA inputs. This is used during panning. For fading and voltage controlled mixing there are two mixed outputs of the two VCAs. 1+2 is a normal additive mix, while 1-2 is a different mix. Note that with a signal patched to 1+2 ONN, the 1+2 output may be as high as 4 times gain, while the 1-2 output can never be higher than 2 times gain.

When using this module, first center all three pots. This sets the initial gain of both VCAs to .5. Turning the pan pot will cause one VCA to go to unity gain as the other goes to zero gain. The individual bias pots can be used to balance the overall effect. Leave the pan pot centered for individual use of the VCAs.

For fading, the two signals to be cross-faded are patched into inputs 1 and 2 respectively. The output is taken from 1+2 or 1-2 output. For panning, the input goes to 1+2 IN and the outputs are taken from the respective 1 and 2 outputs.

<u>VOLTAGE CONTROLLED FILTES (VCF)</u>

HI/LO	Audio/subaudio range selector
GAIN	Attenuator for Main input
Q	Resonance control (also affects gain of Limit input)
VC	Control input with attenuator/inverter for VCQ
FREQ	Bias pot setting initial filter cutoff frequency
VC	Control input with attenuator/inverter for VC frequency
LIMIT	Signal input limited by Q setting
MAIN	Main signal input
HP	High pass output
BP	Band pass output
LP	Low pass output

The function of the VCF is to alter the gain of an input signal with respect to that signal's frequency. The filter cutoff frequency is the reference. For the high pass function, input frequencies below the cutoff frequency will be attenuated. The low pass function attenuates frequencies above the cutoff, while the bandpass function attenuates both above and below the cutoff frequency, allowing only frequencies near the cutoff to pass. The Q function determines the sharpness, or closeness to the cutoff frequency, of the attenuating effect.

Since many waveforms contain a complex distribution of different frequencies which determine the timbre of color of a sound, a VCF is often used to modify timbre. Patch a sawtooth wave into the VCF input and manually vary the cutoff frequency. You will notice the common "wah" effect. Listen to each of the outputs and notice the different effects. Notice the action of the Q control. Patch the signal into the Limit input and notice how the signal is attenuated at high Q settings. The purpose of this limiting function is to obtain a more constant output level since the filter "peaks", increases its output amplitude sharply at the cutoff frequency. Higher Q settings produce higher peaks, so the limit function is used to counteract this effect.

Both the cutoff frequency and the Q are voltage controllable, and an attenuator/inverted similar to that on the ramp modules is provided for processing the control voltage coming in.

In LO range, the VCF can be used to modify control volatges. The outputs have a characteristic sinewave pattern, with the BP and LP outputs being 90 degrees out of phase. The BP output leads the LP output by 1/4 cycle. This is different from 1/2 cycle difference produced by a simple inversion. Try patching in a slow ramp and control something with the output.

Finally, the VCF can be made into a VCO by patching the BP output into the Main input. The output will be a sinewave of about +-10V. The Q and Gain controls must be set fairly high for this to work. Notice that if one of these is decreased slowly, the oscillation dies out gradually, which is sometimes useful.

In this oscillator mode, the HI/LO switch can select audio or subaudio oscillations.

SUGGESTED PATCHES

1. Output of an oscillator to its own VC input. This will yield the concave and convex waveforms diagrammed earlier.

2. Main out of a + ramp to the main input of a - ramp. Using the switch on the + ramp you can initiate a rising ramp (taken from the - ramp main output) that will hold as long as the switch is up and fall when the switch is down. The rise and fall rates can be set individually.

3. Manual gate to the main input of a triangle module. When the switch goes up the main output will rise at the adjustable rate and hold until the swtich is turned down, then fall at the same rate it rose (unless you change the rate control in the meantime)

4. Random pulse output to the sample input of the random module. This will yield random levels at the step outputs at random intervals.

5. Pulse output from a - ramp (patched as an oscillator) to the sample input on the random module. This will yield random voltage levels at the step outputs at regular intervals

-- Richard Brewster 1978

-- revised 1984